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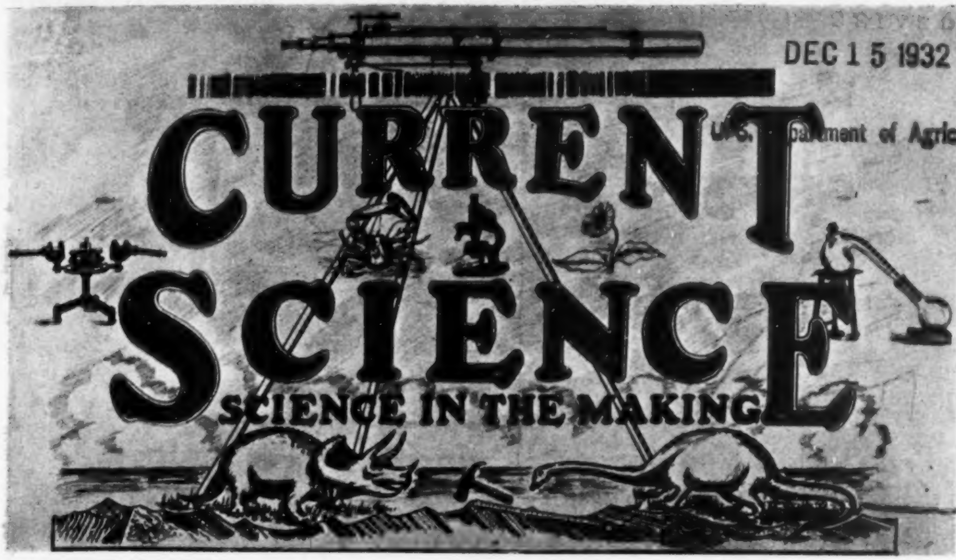

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CONTENTS

The Fiftyfive-Year Rule.

THE fundamental rules relating to the age of retirement of public servants are obviously empirical and operate unevenly within the limits of even a single branch of service. In the case of the higher posts in the judicial department and cabinet, the fiftyfive-year rule is relaxed, while it is more or less rigidly applied to the appointments in other branches of the administration. The age limit imposes practically no bar to the assumption of elective offices by retired government servants, and posts in the gift of the Crown are equally exempt from age restrictions. In all business concerns and industrial organizations, the directing authorities hold their offices virtually for life.

It is commonly argued that the age rule, though a purely arbitrary one, must be upheld in order to maintain in the services a uniformly high standard of efficiency which, it is feared, advancing age is apt to sterilize; and to secure for administrative problems that freshness and optimism of outlook which a comparatively youthful and more energetic mind may reasonably be supposed to possess. From an economic standpoint, the age rule scarcely appears to be a sound business proposition, and the consideration that the wastage due to retirement provides some measure of relief to unemployment seems to be its chief recommendation. Generally speaking it is true that the efficiency of a person depends not only on his protein metabolism but to a large extent also on the climatic conditions of the country in which he lives; and the influence of adverse environmental factors is likely to be more acute in the case of those who, born in more favourable situations, suddenly find themselves in different and more exacting circumstances, than in the case of races who through centuries have become perfectly inured to them. But this is not all. Of still more fundamental importance is the fact that the treatment accorded to the public servant has a direct influence on his official efficiency. It must be within the experience of all officials that if their career is not embittered by disappointments, and on the other hand, their hopes and ambitions are systematically and periodically fulfilled, their capacity for service is retained unimpaired till an advanced old age. The influence of mind on the discharge of duties is far more profound than is commonly recognized.

It is impossible to assume that the age of a person at fiftyfive in itself impairs his mind to the extent of disqualifying him for the performance of public functions. The constant vigilance and tireless energy so necessary for a successful business organization in which the directing authorities have to keep all their fingers on the pulse of the market, finance and labour, do not appear to be foreign to them though they may have crossed the official age limit. The official duties of the Prime Minister and of his colleagues in the Cabinet must be certainly of a very arduous character yet in their assumption, consideration of age plays little or no part. Really we are dealing with two classes of offices in public affairs where an anomalous position is created. Those which are in the gift of the government are regulated by age rules and others virtually in the gift of the electorate are independent of them, though in both the nature and volume of work to be transacted are almost the same, and if there is any difference at all the incidence is certainly heavier in the case of elective appointments. In the reformed constitution in India the ministerial posts are in the majority of cases occupied by retired government officers and others who, according to the fundamental rules, are not permitted to hold any office under government. Further it may be observed that in committees and commissions appointed by Government, officers who have relinquished their posts are also included in large numbers. It seems to us therefore that it is impossible to maintain that the service rules regulating the tenure of offices are based purely on considerations of the efficiency of their incumbents. In any case we have no standard scientifically determined for the measurement of such efficiency, and, this standard, if one is discovered, is unlikely to be suitable for uniform application to all persons in all branches of public administration; for the nature and intensity of the duties and the consequent wear and tear on the individual must differ widely between department and department and also in their effects on individual persons. Obviously, there can be little scientific justification either for fixing fiftyfive years as the general retiring age or for arbitrarily raising this to sixty years only in a few cases. It seems to us that in the interests of both economy and of efficiency, this rule is in need of immediate revision and in support of our view we may adduce the fact that most of the pensioned officers who seek engagements in quasi-public services or who apply for commutation of their pensions are declared to be sound in body and mind by the medical boards. The cost of pension for which the Indian Governments provide in their budgets is excessively heavy and fresh recruitment, on account of retirement under the existing rules, must materially add to the cost of administration.

We are concerned here more with the teaching profession than with any other. In missionary and other aided institutions, the fiftyfive-year rule is not as a matter of principle strictly followed, and in respect of certain endowed chairs in Indian universities their occupants are permitted to continue in office till sixty years of age. In Europe and America the practice varies. German professors, as is well known, are permitted to hold their appointments for life and are State servants. Similarly, the occupants of endowed chairs in English universities are not disturbed so long as they choose to continue to work and even secondary school teachers enjoy their tenure of office till their sixtieth year. Practically in all the progressive countries the European practice is adopted. The case is not materially different in institutions where engagements are entered into on the basis of short-term contract. In them the renewal of engagements has absolutely nothing to do with the age of the person, but is determined solely with reference to his efficiency. In India, however, the teaching posts in government service to whatever grade they may belong, generally terminate at the age of fiftyfive, the Government reserving to themselves the right of granting extensions sometimes even upto sixty years. There can be obviously no magic in the rule and the existing practice which is full of anomalies is capable of being based on some well-recognized psychological and physiological principle. One of the outstanding features of the great moral and material progress of India is the distinct improvement of the sanitary conditions of towns, where a generous supply of wholesome water, pure air, parks and playgrounds and other amenities which secure health and prolong life are available for all and consequently the outlook of life of an average citizen in Indian cities is favourably comparable with that of one in European towns living in similar conditions. What really depresses the soul of the teaching

profession is stagnation and utter lack of variety of work from which the other branches of service do not suffer. To some extent this may be compensated for by the daily contact of the professor with the bubbling enthusiasm of youthful minds, and by the exhilaration that comes from a joyous and unstinted devotion to original investigation that must tend to keep him young and hopeful. We are aware that the conditions of service in the different grades of the teaching profession differ radically and we shall deal here mainly with the members of a university staff.

The decision of the Government to terminate the services of professors at fifty-five years is one of those rules which in their very nature must operate unequally. It is perfectly true that some professors are too old at fifty or even forty, especially such as have neither a hobby nor vital interests beyond absolute routine; it is equally true that others are quite young at sixty-five or even seventy. It seems to us that in the higher branches of education, a living mind endowed with a wide and varied experience, a ripe and unfaltering judgment, a real enthusiasm and power to initiate and conduct research and a judicious temper and discernment must be a more valuable and indispensable asset than buoyance and vigour whether to universities or governments. Such a mind confers prestige and creates tradition. The two-fold nature of the work devolving on a professor demands at once a power and readiness on his part to put himself on a level with young and inexperienced men and a faculty to seek and establish variety in his own work. Age is commonly believed to produce in mind, a warped and embittered view of life, a total lack of sympathy with the overflow of youth, a dogmatic assertiveness "and an idealized memory of the greatness of past time". These effects, it must be remembered, are more pronounced in other walks of life than in teaching and so long as the professor maintains an inquisitive spirit towards learning and research, he is practically immune from the mental disease of old age. There are numerous cases of professors old according to government rules but young enough to retain their original freshness and mobility of mind to be able "to share in the enthusiasm of the young and to travel with them along the same road". The truth is that old age is not due to years but depends largely on circumstances and temperament "and the remedy therefore lies less in general rules than in the treatment accorded to the professor during his career." Compulsory retirement at fiftyfive years, we are convinced, is not a satisfactory remedial measure for a sickness which may have had its origin almost at the commencement of the service or even before. Subsequent conditions may either allay or aggravate the malady.

The first step is to prevent stagnation and routine from bearing unduly upon members of the university staff. For instance, the system of interchange of professors in the early stages of their career, study leave with deputation allowance in addition to usual emoluments and compulsory attendance at scientific and other conferences and congresses must help to keep the professor always alert and efficient. These suggestions may be supposed to be expensive and therefore may not commend themselves to the authorities, but the existing system of retiring the professors is equally exposed to this criticism. The scheme we here suggest has, however, the obvious advantage of securing for the institution concerned the foundations of prestige and tradition which cannot be measured in terms of money. At present Indian universities are labouring under a serious handicap in this respect though in spite of it some have already built up their own reputation, chiefly through the efforts of those who do not come under the fiftyfive-year rule. The absence of tradition is largely due to the operation of the fundamental rules which deprive our institutions of their professors precisely at the time when they are in a position to create it. The plan that we have put forward of releasing the professors for a definite period at regular intervals and of requiring them to spend these intervals in some way beneficial to the institution to which they belong, deserves immediate consideration.

In emphasizing the need and the urgency of revision of the fiftyfive-year rule, we are not asking for the establishment of a new procedure whose effects cannot be foretold. The system of making university posts life-time appointments has proved an advantage and an eminent success in Europe and other countries. In India the fiftyfive-year rule is not applicable to certain class of offices and there is practically no age limit except the disinclination of the person himself for elective offices and those connected with industries. We have no well-tested and absolute standards for measuring

the worth and efficiency of public servants and the vague apprehension that at fiftyfive an officer has ordinarily well-nigh exhausted his capacity for usefulness in public affairs will not stand close scrutiny. As we have pointed out that old age in the teaching profession is less due to advancing years than to circumstances and treatment, we should certainly have no hesitation in advocating the extension of the age limit to sixty years in the first instance, in the case of professors, and if the results are satisfactory, as we are confident that they will prove to be, occasion will not be wanting for a general and more comprehensive review of the rule in its bearing on other branches of educational service as well. The importance of research in our universities and of its power to create a tradition for the country is just beginning to be recognized by the public and the only tangible way of appreciating and encouraging it is to prolong the period of the usefulness of the professors in the universities upto at least sixty years.

Nuclear Structure.

By Prof. B. Venkatesachar, M.A., F.Inst.P., and T. S. Subbaraya, B.Sc.

THE isotopic constitution of a large number of elements is now known, while the study of band spectra and hyperfine-structure of line spectra has, in a considerable number of cases, led to the determination of nuclear spins with more or less certainty. There have been a number of attempts[1] to explain the isotopic constitution. The problem of explaining the observed nuclear spin has also been attacked: S. Bryden[2] and H. E. White[3] have attempted a solution on the hypothesis that nuclear spin is due to the spin and orbital motion of the protons while the electrons in the nucleus are supposed to have lost their spin. But, as Iwanenko[4] suggested and particularly as Heisenberg[5] has shown, it is unnecessary to postulate the separate existence of electrons in the nucleus; we may assume that the nucleus consists of protons and neutrons only. Now Heisenberg has deduced that the system of two protons and two neutrons, namely, an α-particle, is very stable. Hence we are led to postulate that pairs of protons and neutrons within the nucleus combine into as many α-particles as possible, an α-particle having, of course, no spin. When this is done the number of α-particles, protons and neutrons that compose a nucleus of atomic weight N and atomic number Z can be uniquely determined. The number of α-particles is the integral part of Z/2, and when Z is odd there is one proton. The number of neutrons is N − 2Z or N − 2Z+1 according as Z is even or odd. To take an example, O_{17}, Z=8 contains 4 α-particles, no proton and 1 neutron, while Cl_{37}, Z=17 contains 8 α-particles, 1 proton and 4 neutrons. That Pauli's principle should apply to neutrons also has been pointed out by Heisenberg[6]. Considerations of the statistics of nitrogen nuclei have led him to postulate that every neutron has a spin of $\frac{1}{2}\, h/2\pi$. The occurrence of a large nuclear spin like 9/2 in the case of a few elements while in many other cases it is small, suggests that shells of neutrons which possess orbital motion must contribute to the nuclear spin. Accordingly, we have in this work assumed that the nucleus consists of Z/2 α-particles, and 1 proton when Z is odd, with N − 2Z or N − 2Z+1 neutrons. The α-particles have no spin, and the contribution of the neutrons to the nuclear spin is the resultant of their spin and orbital moments while the resultant moment of the nucleus is equal to that of the neutrons together with that of the single proton if present. The resultant moment of the neutrons can then be calculated exactly as the resultant j-value in the case of extranuclear electrons. We may expect that the observed spin will be that corresponding to the j-value of the deepest term. Table I shows how far this procedure leads to the observed spins.

The above table shows that in the majority of cases the observed spin corresponds to the j-value of the deepest term. In the case of V, Mn, Cu, Ga, Cd, Sb, I, Cs, Ba_{137}, La, Pr and Pb the observed i-value (nuclear spin) does not correspond to the j-value of the theoretically deepest term, but to that of one of the other

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[1] W. D. Harkins, *Phys. Rev.*, **38**, 1270, 1931. H. C. Urey, *J. Am. Chem. Soc.*, **53**, 2872, 1931. J. H. Bartlett, *Nature*, **130**, 165, 1932.
[2] S. D. Bryden, Jr., *Phys. Rev.*, **38**, 1989, 1931.
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[4] D. Iwanenko, *Nature*, **129**, 798, 1932.
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[6] W. Heisenberg, *Zs. f. Phys.*, **78**, 159, 1932.

TABLE I.

Nucleus	(Z) Atomic Number	No. of α-particles	No. of Protons	No. of Neutrons	Neutronic Configuration	j-values of deepest and some deep terms, l-s coupling	j-values of deepest and some deep terms, J-J coupling	Observed Spin	Calculated Spin including that of proton
H	1	—	1	—	—	—	—	$\frac{1}{2}$	$\frac{1}{2}$
He	2	1	—	—	—	—	—	0	0
Li_6	3	1	1	1	$1s^1$	$\frac{1}{2}$ ($^2S_{\frac{1}{2}}$)	$\frac{1}{2}$	0	1 or 0
Li_7	3	1	1	2	$1s^2$	0 ($^1S_0$)	0	$\frac{3}{2}$	$\frac{1}{2}$
C_{12}	6	3	—	—	—	—	—	0	0
N_{14}	7	3	1	1	$1s^1$	$\frac{1}{2}$ ($^2S_{\frac{1}{2}}$)	$\frac{1}{2}$	1	1 or 0
O_{16}	8	4	—	—	—	—	—	0	0
F	9	4	1	2	$1s^2$	0 ($^1S_0$)	0	$\frac{1}{2}$	$\frac{1}{2}$
Ne	10	5	—	—	—	—	—	0	0
Na	11	5	1	2	$1s^2$	0 ($^1S_0$)	0	$\geqslant \frac{1}{2}$	$\frac{1}{2}$
P	15	7	1	2	$1s^2$	0 ($^1S_0$)	0	$\frac{1}{2}$ or 1	$\frac{1}{2}$
Cl_{35}	17	8	1	2	$1s^2$	0 ($^1S_0$)	0	$\frac{5}{2}$	$\frac{1}{2}$
K_{39}	19	9	1	2	$1s^2$	0 ($^1S_0$)	0	$\frac{1}{2}$	$\frac{1}{2}$
Ca	20	10	—	—	—	—	—	0	0
V	23	11	1	6	$2p^2$	0, 1, 2 ($^3P_{0,1,2}$)	0 ; 1, 2	$\geqslant \frac{5}{2}$	$\frac{1}{2}$, $\frac{3}{2}$ or $\frac{5}{2}$
Mn	25	12	1	6	$2p^2$	0, 1, 2 ($^3P_{0,1,2}$)	0 ; 1, 2	$\frac{5}{2}$	$\frac{1}{2}$, $\frac{3}{2}$, or $\frac{5}{2}$
Fe	26	13	—	4	$2s^2$	0 ($^1S_0$)	0	0	0
Cu	29	14	1	6	$2p^2$	0, 1, 2 ($^3P_{0,1,2}$)	0 ; 1, 2	$\frac{3}{2}$	$\frac{1}{2}$, $\frac{3}{2}$ or $\frac{5}{2}$
Ga	31	15	1	8	$2p^4$	2, 1, 0 ($^3P_{2,1,0}$)	0, 2 : 1, 2	$\geqslant \frac{3}{2}$ ($\frac{1}{2}$?)	$\frac{5}{2}$, $\frac{3}{2}$ or $\frac{1}{2}$
As	33	16	1	10	$2p^6$	0 ($^1S_0$)	0	$\frac{3}{2}$	$\frac{1}{2}$
Br	35	17	1	10	$2p^6$	0 ($^1S_0$)	0	$\frac{3}{2}$	$\frac{1}{2}$
Rb	37	18	1	12	$3s^2$	0 ($^1S_0$)	0	$\geqslant \frac{1}{2}$	$\frac{1}{2}$
Sr	38	19	—	12	$3s^2$	0	0	0	0

Nucleus	(Z) Atomic Number	No. of α-particles	No. of protons	No. of Neutrons	Neutron Configuration	*j*-values of deepest and some deep terms, l-s coupling	*j*-values of deepest and some deep terms, J-J coupling	Observed Spin	Calculated Spin including that of proton
Cd_{111}	48	24	—	15	$3p^3$	$\frac{1}{2}, \frac{3}{2}, \frac{1}{2}$ ($^4S_{3/2}, {}^2P_{\frac{1}{2}, 3/2}$)	$\frac{3}{2}; \frac{1}{2}, \frac{3}{2}, \frac{5}{2}$	$\frac{1}{2}$	$\frac{3}{2}, \frac{1}{2}$ or $\frac{5}{2}$
Cd_{113}	48	24	—	17	$3p^5$	$\frac{3}{2}, \frac{1}{2}$ ($^2P_{3/2, \frac{1}{2}}$)	$1\frac{1}{2}, \frac{1}{2}$	$\frac{1}{2}$	$\frac{3}{2}$ or $\frac{1}{2}$
In	49	24	1	18	$3p^6$	0 ($^1S_0$)	0	$\frac{1}{2}$	$\frac{1}{2}$
Sb_{121}	51	25	1	20	$4s^2$	0 ($^1S_0$)	0	(?)	$\frac{1}{2}$
Sb_{123}	51	25	1	22	$3d^2 4s^2$	$^3F_{2, 3, 4}\ {}^3P_{0, 1, 2}$	0, 2; 1, 2, 3, 4	$\frac{3}{2}$	$\frac{5}{2}, \frac{1}{2}, \frac{3}{2}$ or $\frac{9}{2}$
I	53	26	1	22	$3d^2 4s^2$	2, 3, 4; 0, 1 ($^3F_{2, 3, 4}\ {}^3P_{0, 1, 2}$)	0, 2; 1, 2, 3, 4	$\frac{9}{2}$	$\frac{5}{2}, \frac{7}{2}$ or $\frac{9}{2}$ &c.
Cs	55	27	1	24	$3d^4 4s^2$	2, 3, 4; 0, 1, 2 ($^3F_{2, 3, 4}\ {}^3P_{0, 1, 2}$)	0; 1, 2, 3, 4	$\geqslant \frac{5}{2}$	$\frac{5}{2}, \frac{3}{2}, \frac{1}{2}, \frac{7}{2}$ or $\frac{9}{2}$
Ba_{135}	56	28	—	23	$3d^3 4s^2$	$\frac{3}{2}, \frac{5}{2}, \frac{7}{2}, \frac{9}{2}$ ($^4F_{3/2, 5/2, 7/2, 9/2}$)	$\frac{3}{2}; \frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \frac{7}{2}$	$\frac{3}{2}$	$\frac{3}{2}$ &c.
Ba_{137}	56	28	—	25	$3d^5 4s^2$	$^6S_{5/2}, {}^4D_{\frac{1}{2}, 3/2, 5/2, 7/2}$	$\frac{5}{2}; \frac{1}{2}, \frac{3}{2}, \frac{5}{2}$	$\frac{3}{2}$	$\frac{5}{2}$ or $\frac{1}{2}$ or $\frac{3}{2}$
La	57	28	1	26	$3d^6 4s^2$	$^5D_{4, 3, 2, 1, 0}$	0, 2, 4	$\frac{5}{2}$	$\frac{1}{2}, \frac{5}{2}$ or $\frac{9}{2}$
Pr	59	29	1	24	$3d^4 4s^2$	0,1,2,3,4 ($^5D_{0, 1, 2, 3, 4}$)	0, 2, 4	$\frac{5}{2}$	$\frac{1}{2}, \frac{5}{2}$ or $\frac{9}{2}$
Hg_{199}	80	40	—	39	$4d^1 5s^2$	$^2D_{3/2, 5/2}$	$\frac{3}{2}, \frac{5}{2}$	$\frac{1}{2}$	$\frac{3}{2}$ or $\frac{5}{2}$
Hg_{201}	80	40	—	41	$4d^3 5s^2$	$\frac{3}{2}, \frac{5}{2}, \frac{7}{2}, \frac{9}{2}$	$\frac{3}{2}, \frac{1}{2}, \frac{3}{2}$	$\frac{3}{2}$	$\frac{3}{2}$ or $\frac{1}{2}$
Tl	81	40	1	42	$4d^4 5s^2$	2, 3, 4; 0, 1, 2	0, 2, 4	$\frac{1}{2}$	$\frac{1}{2}$ or $\frac{3}{2}$ &c.
Pb_{207}	82	41	—	43	$4d^5 5s^2$	$^6S_{5/2}, {}^4D_{\frac{1}{2}, 3/2, 5/2, 7/2}$	$\frac{5}{2}; \frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \frac{7}{2}$	$\frac{1}{2}$	$\frac{5}{2}$ or $\frac{1}{2}$ &c.
Bi	83	42	1	44	$4d^6 5s^2$	$^5D_{4, 3, 2, 1, 0}$	0, 2, 4	$\frac{9}{2}$	$\frac{9}{2}, \frac{1}{2}$ or $\frac{5}{2}$

deep terms. In the case of Li_7, Cl_{35}, As, Br, and Hg_{199} the spin does not follow from the configuration assumed, but if one neutron is supposed to be in a different orbit the observed spin may be accounted for. (1s 2s, 1s 2p, $2p^5 3s$, $2p^5 3s$ and $4d^2 5s^1$ would be the configurations in the case of Li_7, Cl_{35}, As, Br and Hg_{199} respectively). Such deviations from expectation are frequently met with in extranuclear configurations.

Further evidence in support of the structure assumed for the nuclei can be obtained from the known atomic weights of the lightest, heaviest and most abundant isotopes of the elements. In Table II the neutron configurations corresponding to these are given for all the elements for which data are available. This table shows that the most abundant isotope is in a majority of cases that which has a closed shell or subshell of neutrons. In those instances in which this is not the case, the neutron configuration of the most abundant isotope is seen to be one which may be expected to be very stable from the analogy of extra-nuclear electronic configurations.

TABLE II.

Atomic Number	Element	Lightest Isotope	Neutron Configuration of same	Heaviest Isotope	Neutron Configuration of same	Most abundant Isotope	Neutron Configuration of same
1	H	1	—	2	$1s^1$	1	—
2	He					4	—
3	Li	6	$1s^1$			7	$1s^2$
4	Be					9	$1s^1$
5	B	10	$1s^1$			11	$1s^2$
6	C	12	—	13	$1s^1$	12	—
7	N	14	$1s^1$	15	$1s^2$	14	$1s^1$
8	O	16	—	18	$1s^2$	16	—
9	F					19	$1s^2$
10	Ne	20	—	22	$1s^2$	20	—
11	Na					23	$1s^2$
12	Mg	24	—	26	$1s^2$	24	—
13	Al					27	$1s^2$
14	Si	28	—	30	$1s^2$	28	—
15	P					31	$1s^2$
16	S	32	—	34	$1s^2$	32	—
17	Cl	35	$1s^2$	37	$2s^2$	35	$1s^2$
18	A	36	—	40	$2s^2$	40	$2s^2$
19	K	39	$1s^2$	41	$2s^2$	39	$1s^2$
20	Ca	40	—	44	$2s^2$	40	—
21	Sc					45	$2s^2$
22	Ti					48	$2s^2$
23	V					51	$2p^2$
24	Cr	50	$1s^2$	54	$2p^2$	52	$2s^2$
25	Mn					55	$2p^2$
26	Fe	54	$1s^2$	56	$2s^2$	56	$2s^2$
27	Co					59	$2p^2$
28	Ni	58	$1s^2$	60	$2s^2$	58	$1s^2$
29	Cu	63	$2p^2$	65	$2p^4$	63	$2p^2$
30	Zn	64	$2s^2$	70	$2p^6$	64	$2s^2$
31	Ga	69	$2p^4$	71	$2p^6$	69	$2p^4$
32	Ge	70	$2p^2$	77	$3s^1$	74	$2p^6$
33	As					75	$2p^6$
34	Se	74	$2p^2$	82	$3p^2$	80	$3s^2$
35	Br	79	$2p^6$	81	$3s^2$	79	$2p^6$

Element	Lightest Isotope	Neutron Configuration of same	Heaviest Isotope	Neutron Configuration of same	Most abundant Isotope	Neutron Configuration of same	Atomic Number
Kr	78	$2p^2$	86	$3p^2$	84	$3s^2$	36
Rb	85	$3s^2$	87	$3p^2$	85	$3s^2$	37
Sr	86	$2p^6$	88	$3s^2$	88	$3s^2$	38
Y					89	$3s^2$	39
Zr	90	$2p^6$	96	$3p^4$	90	$2p^6$	40
Mo	92	$2p^4$	100	$3p^4$	98	$3p^2$	42
Ru	96	$2p^4$	104	$3p^4$	102	$3p^2$	44
Ag	107	$3p^2$	109	$3p^4$	107	$3p^2$	47
Cd	110	$3p^2$	116	$4s^2$	114	$3p^6$	48
In					115	$3p^6$	49
Sn	112	$3s^2$	124	$3d^4 4s^2$	120	$4s^2$	50
Sb	121	$4s^2$	123	$3d^2 4s^2$	121	$4s^2$	51
Te	122	$3p^6$	130	$3d^6 4s^2$	130	$3d^6 4s^2$	52
I					127	$3d^2 4s^2$	53
?X	124	$3p^4$	136	$3d^8 4s^2$	129	$3d^1 4s^2$	54
Cs					133	$3d^4 4s^2$	55
Ba	135	$3d^2 4s^2$	138	$3d^6 4s^2$	138	$3d^6 4s^2$	56
La					139	$3d^6 4s^2$	57
Ce	140	$3d^4 4s^2$	142	$3d^6 4s^2$	140	$3d^4 4s^2$	58
Pr					141	$3d^4 4s^2$	59
Nd	142	$3d^2 4s^2$	146	$3d^6 4s^2$	142	$3d^2 4s^2$	60
W	182	$4p^4$	186	$5s^2$	184	$4p^6$	74
Re	185	$4p^6$	187	$5s^2$	187	$5s^2$	75
Os	186	$4p^4$	192	$4d^2 5s^2$	192	$4d^2 5s^2$	76
Hg	196	$4p^6$	204	$4d^6 5s^2$	202	$4d^4 5s^2$	80
Tl	203	$4d^4 5s^2$	205	$4d^6 5s^2$	203	$4d^4 5s^2$	81
Pb	206	$4d^4 5s^2$	208	$4d^6 5s^2$	208	$4d^6 5s^2$	82
Bi					209	$4d^6 5s^2$	83
Po	210	$4d^4 5s^2$	218	$5p^2$	210	$4d^4 5s^2$	84
Ra Em	219	$4d^9 5s^2$	222	$5p^2$	222	$5p^2$	86
Ra	223	$4d^9 5s^2$	228	$5p^4$	226	$5p^2$	88
Ac	227	$5p^2$	228	$5p^3$	227	$5p^2$	89
Th	227	$4d^9 5s^2$	234	$5p^6$	232	$5p^4$	90
Pa	231	$5p^2$	234	$5p^5$	231	$5p^2$	91
U	234	$5p^2$	238	$5p^6$	238	$5p^6$	92

It will also be seen that similar neutron configurations give rise to the most abundant isotope irrespective of the total quantum number of the neutron shells. Thus $2p^2$, $3p^2$ and $5p^2$ occur equally often; so also $2p^4$ and $5p^4$ occur once. $3d^4 4s^2$ and $4d^4 5s^2$ occur the same number of times, while $3d^6 4s^2$ and $4d^6 5s^2$ also appear almost equally frequent. If we compare the relative abundance of the elements from Ca to Ni

we find that the elements having the electronic configurations d^2s^2, d^4s^2 and d^6s^2 are almost equally abundant but for the extraordinary abundance of Fe. So also the neutronic configurations d^2s^2, d^4s^2 and d^6s^2 equally often represent most abundant isotopes. All these regularities show that the tentative scheme here put forward represents one aspect of reality at least and leads us to hope that we may be on the right track. We have not tried to emphasize the regularities exhibited by the lightest and heaviest isotopes because we cannot here regard the present data as final. According to the scheme here put forward X_{129} cannot be expected to be the most abundant isotope of Xenon. X_{132} is nearly as abundant as X_{129} and has a stable configuration ($3d^4 4s^2$). That there is some difficulty with regard to this element is also clear from the fact that the chemical atomic weight differs from that calculated from the relative abundance of the isotopes. In the case of light elements up to Oxygen, the configuration of 1 extra neutron and 1 proton seems to be stabler than that of 2 neutrons forming a closed s-shell. Thus although Li_7 is more abundant than Li_6, considerations of its spin show that its neutron configuration cannot be $1s^2$. In the case of Be, the one neutron cannot be very stable. Possibly this has something to do with the fact that the first discovery of the neutron was made by bombarding Be by α-rays. It is also very interesting to note that the regularity exhibited by the radioactive elements and their isotopes is similar to that shown by elements preceding them.

The Concept of Causality.

THE above is the title of the Seventeenth Guthrie Lecture delivered by Prof. Max Planck before the London Physical Society on the 17th June. Recent advances in theoretical physics have impelled physicists to examine the concept of causality and its position in modern physics. In classical physics the existence of a causal relation was looked upon as a truism. Max Planck considers in his very interesting and thought-provoking address whether the position of the law of causality has been materially altered by quantum mechanics. The Professor starts by defining a causal link. "At the outset," he says, "we agree that in speaking of a causal link between two successive events we mean a certain connection, subject to law, between the two events of which the earlier event is called the cause, the later one the effect"; and again "an event is causally conditioned if it can be predicted with certainty". Starting from this definition he makes a careful examination of the concept in the light of recent advances in Physics and comes to the conclusion that "the world picture in quantum physics is governed by the same rigorous determinism which rules classical physics". One of the most interesting contributions to the enquiry is the way he tries to solve the problem by postulating an ideal mind. The reliability of any weather forecast depends on the knowledge of the meteorologist who predicts; the more knowledge he possesses of the atmospheric and other conditions of to-day the more reliable will be his predictions of to-morrow. Extrapolating, we may say that "an ideal mind, apprehending everywhere all the physical occurrences of to-day in their minutest points, should be able to predict with absolute accuracy the weather of to-morrow in all its details." This may be extended to other physical events.

Finally, "the law of causality is neither right nor wrong, it can be neither generally proved nor generally disproved. It is rather a heuristic principle, a sign-post (and to my mind the most valuable sign-post we possess) to guide us in the motley confusion of events and to show us the direction in which scientific research must advance in order to attain fruitful results. As the law of causality immediately seizes the awakening soul of the child and causes him indefatigably to ask "Why?" so it accompanies the investigator through his whole life and incessantly sets him new problems. For science does not mean contemplative rest in possession of sure knowledge, it means untiring work and steadily advancing development."

Importance of Dialysis in the Study of Colloids.

By Dr. B. N. Desai, M.Sc., Ph.D., B.A., LL.B.,
Wilson College, Bombay.

IN recent papers published from the Allahabad Laboratory, Dhar and collaborators[1] have studied some properties, *viz.*, viscosity and flocculation values with different electrolytes of colloidal solutions diluted and also dialysed to different extents. In their first paper Dhar and Gore have stated, "it appears also that research in colloid chemistry has not been systematic because each experimenter prepared the sol in his own particular manner, and the colloid contained different impurities and hence the stability and other properties are likely to vary from one specimen to another of the same sol prepared in different ways." From these papers one gets an impression that Dhar and collaborators were the first to find how the properties of a colloidal solution can be modified by varying its purity, *i.e.*, by subjecting it to dialysis. This impression is incorrect in that Desai[2] drew for the first time attention to the fact that a colloid can be made to show either normal or abnormal behaviour to the dilution rule when it is coagulated by electrolytes containing monovalent coagulating ion by subjecting the colloid to dialysis for different periods, and that it is erroneous to classify colloids into two divisions according to their behaviour towards the dilution rule as done by Dhar and collaborators. Since then papers have been published by Desai and collaborators[3] in which it has been shown how the properties, *viz.*, (1) stability (as determined by coagulating concentration) towards electrolytes and non-electrolytes, (2) behaviour towards the dilution rule, (3) behaviour towards the Schulze-Hardy Law, (4) auto-catalytic nature of the coagulation process, (5) relation between charge (as deduced from cataphoretic speed measurements on the assumption that the rate of migration represents density of the charge) and stability, and (6) relation between charge and viscosity of a colloidal solution can be made to vary by subjecting it to dialysis for different periods.

In a previous note[4] it was stated "the electro-viscous effect will produce a continuous *decrease* in the viscosity during the period when the charge on colloid increases with the progress of dialysis." It should have been "the electro-viscous effect will produce a continuous *increase* in the viscosity....when the charge on the colloid increases....dialysis." The concentration of the colloid did not change appreciably during dialysis and hence viscosity will not change as a result of it. Of the various factors discussed there, *viz.*, (1) electro-viscous effect, (2) hydration, (3) structure of the particles, and (4) electrolyte content, factors (1), (2) and (3) will increase viscosity in the initial stages of dialysis of thorium hydroxide (*i.e.*, till the maximum value of the charge is reached), factor (1) being most important; on the other hand, during the later stages of dialysis (*i.e.*, when the charge begins to decrease after the maximum value is reached) the increase in viscosity might be due to factors (2) and (3), the former having a marked effect and the influence of factor (1) on viscosity being not allowed to be noticed at all. Therefore, one can conclude that neither the view of v. Smoluchowski[5] nor of Dhar[6] can individually explain the changes in charge and viscosity with the progress of dialysis in the case of colloidal thorium hydroxide.

From our measurements of the cataphoretic speed with the progress of dialysis of colloidal solutions of gold, ferric hydroxide and thorium hydroxide we have found that in all the cases the charge on the colloidal particles first increases and then decreases (concentration of the colloid did not change appreciably during dialysis). We have observed that generally the cataphoretic speed first increases and reaches a maximum value on the addition of small amounts of an electrolyte with univalent coagulating ion, and then decreases on the addition of further larger amounts of the electrolyte (unpublished results). The initial increase in the cataphoretic speed is due to "preferential" adsorption of the similarly charged ion, the word "preferential" being used to indicate that the ion goes to the inner side—nearest to the particle of the double layer. (In the case of sols containing only traces of the peptising agent—highly purified sols—the initial increase in the cataphoretic speed in the presence of small amounts of an electrolyte is not well pronounced.) The process of dialysis can be taken without any serious objections as the reverse of the above process because the amount of the peptising agent initially present in the sols is appreciably more than what will correspond to the maximum in the cataphoretic speed—concentration curve of the colloid with the peptising agent, and therefore the charge on the colloid will first increase and then decrease with the progress of dialysis (*cf.* Freundlich, *Colloid and Capillary Chemistry*, 1926, English Translation, p. 506). The decrease in charge in the later stages of dialysis is due to removal of stabilising agent from the double layer. Therefore if a colloidal solution

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[1] Dhar and Gore, *J. Indian Chem. Soc.*, **6**, 31, 641, 1929 and Mitra and Dhar, *ibid.*, **9**, 315, 1932.

[2] *Kolloidchem. Beihefte*, **26**, 384, 1928.

[3] Patel and Desai, *Trans. Faraday Soc.*, **26**, 128, 1930; *Kolloid-Zeit.*, **51**, 318, 1930; Nabar and Desai, *Nature*, **127**, 666, 1931; Desai and Barve, *ibid.*, **128**, 907, 1931; Desai, *Current Science*, **1**, 37, 1932; paper by Desai, Nabar and Barve on "Relation between charge and stability of colloidal solutions of gold and ferric hydroxide dialysed to different extents" (in course of publication) and paper by Desai on "A note on the existence of critical potential characteristic of coagulation of a colloid by an electrolyte" (in course of publication).

[4] Desai, *Current Science*, **1**, 38, 1932.

[5] *Kolloid-Zeit.*, **18**, 194, 1916; also see Kruyt and his co-workers, *Kolloidchem. Beihefte*, **28**, 1, 1929 and **29**, 413, 1929.

[6] Mitra and Dhar, *loc. cit.*

initially contains an amount of an electrolyte which is greater than what will correspond to the maximum in the cataphoretic speed-concentration curve of that colloid with the particular electrolyte, the charge on the colloid when it is subjected to dialysis will first increase and then decrease. On the other hand, if the amount of the electrolyte initially present is equal to or less than what will correspond to the maximum in the cataphoretic speed-concentration curve, the charge on the colloid will continuously decrease with the progress of dialysis.

The changes which will be produced in the charge on the particles of a colloidal solution with the progress of dialysis are not so simple as many colloid chemists seem to imagine. It is clear that results of viscosity and stability as determined by the coagulating concentration of an electrolyte cannot always be utilized for getting an idea about the charge on the colloidal particles, for whether there is any relationship between charge and viscosity and charge and stability will depend upon the amount of the stabilising agent initially present in the sol besides other factors like hydration, etc. Under the circumstances it is difficult to understand how far one should consider as satisfactory the interpretations of the results of coagulation of colloids by electrolytes whenever inferences have been drawn from those results about charge on the colloidal particles; also one cannot get an idea of the extent to which preferential adsorption of either the stabilising or of the coagulating ion takes place from viscosity and flocculation value determinations. It is, therefore, necessary that simultaneous measurements of charge, viscosity, flocculation value, etc., of every colloidal solution containing varying amounts of the peptising agent (this can be done by subjecting the colloidal solution to dialysis for different periods) should be made in order to get a clear idea about the relationship between charge and other properties. In our Laboratory we are investigating various colloidal solutions from these points of view.

Present Position of the Problem of Spike Disease.*

By M. Sreenivasaya.

TWO schools of thought have influenced the study of Spike Disease both in the field and in the laboratory, since its discovery by McCarthy in the year 1899. Exponents of the physiological school believed that the characteristic symptoms induced in sandal are due to the imposition of an unfavourable environment, brought about by drought, fire, deprival or death of host plants, unbalanced sap circulation, unfavourable host plants and other purely physiological causes. In 1917, Dr. Coleman lent brilliant experimental support to the "infectious theory" of spike disease by the experimental disease transmissions he was able to effect by cleft grafting, the scion for the operation being derived from a diseased plant. This achievement marks a definite stage in the history of spike investigation.

Cleft grafting is a difficult technique; the percentage of success is small, even in the hands of the expert: the operation involved the cutting back of the stock and this gave the plant "a severe physiological shock," in the words of the exponents of the physiological theory, who tried to explain away the most important and definite result achieved by Dr. Coleman.

It is true that his experiments were conducted on stocks growing under natural conditions; it is also true that the host plants nourishing the operated stocks were not determined. Other methods of transmission by budding and sap injection had failed. It was at this stage, that the problem was taken up by the Indian Institute of Science in the year 1927, the Government of Madras and the Commission of Coorg having generously agreed to finance the scheme proposed by Dr. Norris.

Culture of sandal plants in pots in association with known species of hosts marked the next important stage in the progress of Spike Disease investigation. This achievement simple as it appears at the moment, helped to remove the reproach inherent to experiments conducted under un-controlled, natural conditions where many unknown and non-determinable factors operate. All experiments conducted at the Institute have been done with pot cultured sandal plants, whose nourishing host, age and physiological condition are all definitely known.

The development and perfection of an easy and an effectively reproducible artificial disease transmission is an important step indispensable to the progress of the investigation; new methods of disease transmission, extremely simple and elegant involving no "physiological shock" to the operated stock, have now been evolved; the weight of the infective material has been reduced to a few milligrams of diseased tissue. This method which has lent itself to quantitative control, has been of immense value in evaluating the relative resistance or comparative suscepti-

* Abstract of a lecture delivered at Coimbatore, under the auspices of the Society of Biological Chemists, India, on 8th October 1932.

bility of individual sandal plants growing under different conditions of environment; the technique has also been employed in determining the resistance offered by a composite environment to artificial infection.

The simplest and the readiest way of diagnosing spike is through the external symptoms; but the method often fails even in the case of the experienced observer. This is how the exponents of the physiological theory have been misled and have mistaken these symptoms generally produced through drought, fire, etc., as those of genuine spike. Symptoms produced through physiological causes are not communicable to other healthy plants through grafting while those of genuine spike are readily transmissible. Communicability of the symptom from one plant to another is the criterion on which infectious nature of spike disease has been firmly established.

Relative immunity can be imparted to the sandal plants by nourishing them with certain types of host plants, generally non-leguminous. *Pongamia glabra*, *Cajanus indicus* and *Acacias*, generally those which favour a rapid growth of the parasite, render it particularly susceptible to disease. The observation is borne out not only by ecological survey of the diseased and healthy areas, but also in the regeneration plots where only those associated with leguminous hosts have succumbed to the disease.

Mr. Dover of the Forest Research Institute, Dehra Dun, supplemented the lecture with an account of the entomological work which is at present mainly directed to prove whether insects are vectors or not.

Letters to the Editor.

Nomenclature of Shell Layers.

MAY I crave the courtesy of the columns of the *Current Science* to reply to a criticism of the terminology for the various shell-layers as used in my recent Memoir on *Pila* in the *Indian Zoological Memoirs*' series, by Dr. C. Amirthalingam in his note entitled "Correlation of Sex and Shell Structure in a Mollusc—*Trochus niloticus* Linn," published in your September issue? In his first footnote Dr. Amirthalingam remarks, "The terms used here are those generally accepted by English-speaking authors; those used in a Memoir on *Pila* (*The Indian Zoological Memoirs*) differ from this terminology." Leaving out of consideration the use of the structural names, nacreous and prismatic layers, the main differences in the terms employed by Dr. Amirthalingam and myself are in reference to the use of the terms Ostracum and Hypostracum. On a reference to the literature it will be seen that the terms ostracum and hypostracum were introduced into literature by Thiele[1] in 1892. The term hypostracum was used by Thiele in a loose sense for the innermost layer of the shell. In shells of *Chiton* he designated the entire innermost layer as the hypostracum, but in the account of *Patella* he restricted this name to the shell-layer in the region of attachment of the columellar muscle. Later in the same paper when describing the shell of *Gibbula magus*,—a Trachid,—he designated the innermost shell-layers of the upper whorls of the shell, which are in no way connected with the columellar muscle, as the hypostracum. This confusion in the use of the term hypostracum was pointed out by Simroth[2] who concluded "Es ist whol klar, dass man diese locale, unbedeutende Schicht kaum mit Thiele (s.o.) als Hypostracum deuten kann. Wenn man den Ausdruck festhalten will, dann kann bloss die Perlmutterschicht, sowiet sie von der ganzen Mantelfläche abgeschieden wird, bezw. die innere vierte Schicht von *Buccinum* als Hypostracum gelten." The usage of the term hypostracum in the original confused sense of Thiele is followed in an English text-book by Pelseneer,[3] the famous Belgian malacologist and not an "English-speaking" worker, while I have used it in the modified sense of Simroth, as has been done by other workers like Robert[4] in Trochidæ and Bergenhayn[5] for Mollusca in general.

I have also to enter here a protest against the introduction of the new term—gonidial twist—which is apparently meant to replace

[1] Thiele, J., *Zeitschr. wiss. Zool.*, **55**, 220, 1892.

[2] Simroth, H., *Gastropoda-prosobranchia in Bronn's Tierreichs-Mollusca*, **3** (2), 232, 1899.

[3] Pelseneer, P., *Lankester's Treatise of Zoology*, Pt. V, *Mollusca*, p. 4, 1906.

[4] Robert, A., *Zool. Descriptive*, II, p. 382, 1900.

[5] Bergenhayn, J. R. M., *Kungl. Svensk.-Akad. Handl.*, (3) **9**, No. 3, p. 1, 1930.

the generally accepted term Visceral mass (of English authors), Sac visceral (of French) or Eingeweidesack (of German workers). In *Trochus*, as in Gastropods in general, the hermaphrodite gland, the ovary or the testis, as the case may be, is attached mainly on the upper surface of the upper whorls of the twisted visceral mass in the apical part of the digestive gland or the liver, and the designation of the apical whorls of the visceral mass as the gonidial twist cannot possibly be accepted as correct.

BAINI PRASAD.

Indian Museum, Calcutta,
October 1, 1932.

Indian Blepharoceridæ (*Insecta : Diptera*).

IN concluding his third note on the Indian Blepharoceridæ, Dr. A. L. Tonnoir[1] has pointed out that "no further important progress in the knowledge of the Blepharocerid fauna of India can be made unless collectors concentrate more on obtaining the adult stages rather than the early ones." A study of the larvæ and pupæ, though inadequate for toxonomic purposes, has already revealed that in India the Blepharocerid fauna is "the richest of the world in the number of genera". With a view to interest collectors in these remarkable insects a short account was published[2] of their habits and habitats based upon a series of observations made in the field in different parts of India. Reference was then made to the paucity of the adult material and to the inadequate knowledge of the methods of collecting the flies. In reply to an inquiry Dr. Tonnoir has informed me that sometimes sweeping the vegetation with a net in the vicinity of breeding places yields good results, especially with *Apistomyia*. The males of this genus, however, dance in small swarms high up above waterfalls. The females of many species can be obtained while egg-laying on the rocks right at the water's edge. Sometimes these elusive insects shelter under overhanging rocks or large boulders in the rapids. They have also been observed to flutter slowly just above the surface of the water in the spray of the falls, where it is very difficult to detect them. Dr. Tonnoir has observed that the abundance of the larvæ and pupæ in a particular place does not necessarily denote the presence of a large number of adult insects, and *vice versa*. He found a species of *Edwardsina* clustering in thick masses under overhanging rocks; the flies used to leave this shelter in the afternoon and fly up and down the rapids in millions. During the course of my work on the torrential populations of India I have looked for the flies in the "niches" referred to above, but have found instead a large variety of Empid and the Tipulid flies; probably I have not been fortunate enough to be in the field at the season of eclosion of the Blepharocerid flies.

This note is written with a view to stimulate interest in the collection of the adult stages of the Blepharoceridæ. If pupæ can be removed without injury to the animals, they can be induced to eclose by keeping them on wet cotton in a tube. They should, however, never be submerged under water. It is, however, difficult to breed these insects without adequately reproducing torrential conditions, for their larvæ live on bare and smooth rocks in the fiercest currents.

SUNDER LAL HORA.

Zoological Survey of India,
Indian Museum, Calcutta,
October 4, 1932.

[1] *Rec. Ind. Mus.*, **34**, 275, 1932.

[2] *Jour. Bombay Nat. Hist. Soc.*, **35**, 342, 1931.

Life of the Liquid Drops on the Same Liquid Surface.

IN continuation of his previous papers* on the subject, the author has now studied different methods to prolong the life of the

*1. J. B. Seth, C. Anand and L. D. Mahajan, "Liquid Drops on the Same Liquid Surface," *Phil. Mag.*, **7**, 247, 1929.
2. L. D. Mahajan, "The Effect of the Surrounding Medium on the Life of Liquid Drops," *Phil. Mag.*, **10**, 383, 1930.
3. L. D. Mahajan, "Liquid Drops on the Same Liquid Surface," *Nature*, **126**, 761, 1930.
4. L. D. Mahajan, "Liquid Drops on the Same Liquid Surface," *Nature*, **127**, 70, 1931.
5. L. D. Mahajan, "Size of the Liquid Drops on the Same Liquid Surface," *Phil. Mag.* (in press).
6. L. D. Mahajan, "Size of the Liquid Drops on the Same Liquid Surface," *Current Science*, **1**, 100, 1932.
7. L. D. Mahajan, "Effect of Low Pressure on the Life of Liquid Drops," *Phil. Mag.* (in press).
8. L. D. Mahajan, "Effect of Low Pressure on the Life of Liquid Drops," *Nature* (in press).
9. L. D. Mahajan, "Effect of Disturbing Factors and Temperature on Liquid Drops," *Zeitschrift fur Physik* (in press).
10. L. D. Mahajan, "Theories of Liquid Drops on the Same Liquid Surface," *Physical Review* (in press).

liquid drops on the same liquid surface and has found that the following factors help in prolonging their life:—

Vibration of the liquid surface:—It prolongs the life of the liquid drops on the same liquid surface. The greater the vibrating motion of the liquid surface, the longer is the life of the drops.

Motion of the liquid surface:—It also increases the life of the drops. The greater is the rectilinear velocity of the liquid surface, the longer the floating drops live.

Movement of liquid drops themselves on the calm and motionless surface of the liquid:—This also prolongs their life. This is why the secondary drops have longer life than the primary ones.

Addition of more viscous substance to the mother liquid:—It helps upto a certain limit, but if the viscous substance is added beyond that limit, the formation of such drops becomes impossible.

Viscosity of the surrounding medium:—As it increases, the life of such drops also increases. It has a simple and rectilinear relation with the life of the drop.

Absence of impurities in the surrounding medium:—The presence of impurities in the surrounding medium makes the drops very unstable, while absence of them makes them very stable.

Saturated vapours of the mother liquid:—If saturated vapours of the mother liquid are present in the surroundings the drops become very stable.

Surface viscosity of the mother liquid:—It also affects the floating drops to some extent.

The details of the above conclusions, experiments and examples will be published soon.

L. D. MAHAJAN.

Physics Laboratory,
Mohindra College, Patiala, India,
September 3, 1932.

The Alimentary Glands of the Earthworms of the Genus *Eutyphœus*.

THE glands associated with the alimentary canal of *Eutyphœus* fall under three categories according to their position along the alimentary canal: (*a*) Pharyngeal glands, (*b*) Calciferous glands in the region of the œsophagus, and (*c*) the Alimentary glands[1,2] in the region of the intestine. The glands of the first two groups have been thoroughly investigated on different occasions by several workers, the latest work being that of Stephenson,[3,4] but the alimentary glands have not received any attention so far. I, therefore, determined to investigate the morphology of these structures in the two species of *Eutyphœus* that occur in Lucknow and read a preliminary note before the Zoology Section of the Indian Science Congress in 1923.[5] The chief features of these glands are as follows:—

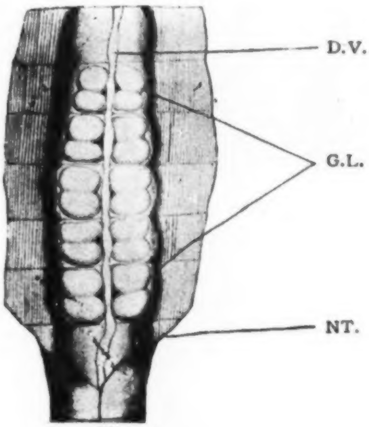

Fig. 1.
Glands as seen in dissection.

The glands are paired structures, fairly conspicuous in the ordinary dissection of the animal, extending over the intestine on either side of the dorsal vessel in four to five consecutive segments, beginning with the segment LXXX backwards. They are separated from each other by the intervening septa and are bilobed, as shown in Fig. 1. These glands are in communication with the alimentary canal by independent openings that are lined by ciliated epithelium, as shown in Fig. 3.

The histology of the glands shows that each is composed of a large number of lamellæ projecting into the cavity of the gland, and these either unite with the adjacent lamellæ or split to reunite (Figs. 2 and 4). Some of the lamellæ are larger than the rest and all of them contain blood spaces,

[1] *Rec. Ind. Mus.*, Calcutta, **10**, 1914.
[2] *Oligochæta* (Oxford Univ. Press), 1930.
[3] *Quart. Jour. Microsc. Sci.*, **62**, 1917.
[4] *Trans. Roy. Soc. Edin.*, **52**, 1919.
[5] *Proc. Tenth Ind. Sci. Cong.*, Lucknow, 1923.

some of which swell up at their free ends owing to the engorgement of the blood.

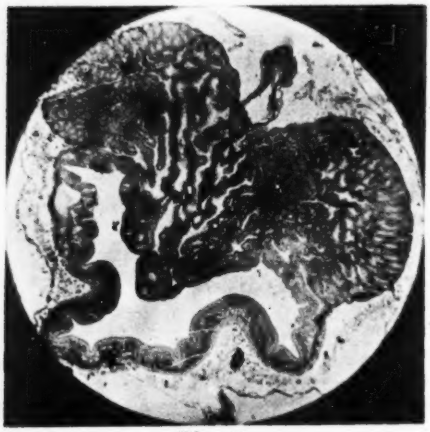

Fig. 2.
Microphotograph of the glands in section.

The glands have peritoneal cells covering the muscular layer, which latter is, however, deficient in the lamellæ. The inner lining of the gland consists of cubical cells full of granular material, which also surround the lamellæ (Fig. 4).

Fig. 3.
Glands near the opening into the intestine showing ciliation.

Fig. 4.
A few lamellæ of the gland showing disposition of cellular structure.

The blood supply of the glands is from the dorsal vessel and also from the subneural vessel. The branches of both the vessels ramify in the substance of the gland and form a complete anastomosis, thereby indicating a kind of portal system. Further investigations may show that the glands are of the nature of a liver that pours a digestive secretion into the gut.

G. S. THAPAR.

Department of Zoology,
University of Lucknow,
September 28, 1932.

Maintenance of Oscillations by a Triode with Filament Feed Cut Off.

WHEN some types of dull emitter tubes, *e.g.*, Cossor 215 P, Cossor 220 P, and Cossor 210 H.F., are made to generate oscillations in the normal way by coupling the grid coil inductively to the oscillatory anode coil, it is found that the oscillations continue to be maintained even when the filament battery is entirely disconnected. The mean anode current, however, as also the oscillatory current, drops to 50 to 80% of the original value and there is a slight reduction in the filament temperature as can be judged by the comparatively fainter glow of the filament. On applying the grid voltage fluctuations to one pair of the deflecting plates of a low voltage Cathode-Ray Oscillograph, it was found that the negative grid swing exceeded 30 volts. The observed filament glow and the electron emission resulting therefrom appear, therefore, to be maintained by the bombardment of the electrons repelled from the grid towards the filament during that major portion of the cycle when the grid is negative with respect to the filament. A series of characteristic curves was drawn for the tubes that show this behaviour, and a careful study of these curves does not reveal the presence of detectable traces of any gas indicating thereby that the filament is bombarded mainly if not exclusively by electrons.

I have not been able to find mention made of this effect anywhere. A more detailed account of the phenomenon will be shortly published elsewhere.

R. L. NARASIMHAIYA.

Department of Physics,
Central College, Bangalore,
October 12, 1932.

A Siluroid Fish from Afghanistan.
Glyptosternum reticulatum McClelland.

Glyptosternum reticulatum was briefly and inadequately described by McClelland in 1842[1] from Sir-i-Chusma, the source of the Kabul River, and since then it has caused considerable confusion in the toxonomy of certain Sisorid fishes. In the August issue of the *Annals and Magazine of Natural History* evidence was adduced to show that *G. reticulatum* is identical with the well-known and widely distributed species "*Parexostoma stoliczkæ* (Day)" and that

[1] *Calcutta Journ. Nat. Hist.*, **2**, 584.

Parexostoma Regan is a synonym of *Glyptosternum* McClelland. These conclusions were based on an examination of abundant material collected by my colleague Dr. B. N. Chopra in the Chitral Valley, from which waters drain into the Kabul River.

Through the courtesy of the Bombay Natural History Society I have received a small collection of fish, comprising 4 specimens, made during August last in the Paghman River, a tributary of the Kabul River, by the Legation Surgeon to the British Legation at Kabul. In this lot there is a well-preserved specimen of *G. reticulatum*, the study of which leaves no doubt whatsoever of the identity of McClelland's much-discussed species with *P. stoliczkæ*, and in consequence changes will have to be made in the nomenclature of these, as well as in the closely allied Sisorid fishes.

SUNDER LAL HORA.

Zoological Survey of India,
Indian Museum, Calcutta,
October 22, 1932.

Gregarious Collembola.

TURK[1] describes the swarming of Collembola in England and Davies[2] indicates the cannibalistic habit observed by him as a factor of swarming. There is no record of these interesting phenomena from India. Since swarming is confined to gregarious species only (Turk)[1], I give below a few examples of gregarious Collembola of Calcutta.

Protanura Carpenteri M,[3] which has been reported by me to be gregarious in habit is found occasionally congregated in large numbers among kitchen garbage in Calcutta. *Onychiurus fimetarious* L, recorded by Handschin[4] from South India, has been observed by me to live in colonies in the crevices of a wall close to a water reservoir. Both immature and mature individuals banded themselves at dusk into groups over the floor adjoining the wall. Swarming took place at the end of last July and specimens formed such a dense mass as to cover nearly the whole of the lower portion of a damp wall of a kitchen. The increase in number was such that specimens for days together were found carried away with the drainage water. The third example of gregarious habit is furnished by a species of *Lepidocyrtus* specimens of which were seen crowded together near the surface of water and a number of their moulted skins occurred matted together.

I have not seen in any of these cases the cannibalistic habit reported for the first time by Davies.[2] Humidity is undoubtedly necessary for the existence of these atracheate species; but I believe, they would not, if the humid condition were favourable and uniform all over the locality, collect themselves into groups, unless there were other factors at work. Although the actual food of the gregarious collembola could not be determined by direct observation,[3] an abundant supply of food as suggested by Turk[1] seems to be the important factor for keeping the members together. The cannibalistic habit referred to, may be explained in a different way as supplementing supply of food at times of scarcity rather than as a factor of swarming.

In discussing factors of swarming of these apterous insects, it should, however, be mentioned whether the term swarming is used in the same sense as in truly social insects as otherwise a confusion may arise between a temporary congregation and swarming that implies an active productive phase and migration for founding new colonies.

DURGADAS MUKERJI.

Zoological Laboratory,
University College of Science,
Calcutta.

[1] *Nature*, **129**, 830, 1932.
[2] *Nature*, **130**, 94, 1932.
[3] *Rec. Ind. Mus.*, **34**, 49, 1932.
[4] *Rev. Suiss. Zool.*, **36**, 236, 1929.

Some Studies in the Infra-Red.

IN continuation with the work on the absorption spectra a self-recording spectrometer is constructed in order to avoid the uncertainties of visual observations which are found to be long and laborious. Since the time of Langley many designs have been suggested, especially by French workers in this field. In the construction of this instrument special precautions have been taken to protect it from stray radiations and to keep the rock-salt prism unaffected by moisture. A definite advance has been made in the technique of the instrument with the result that the fine line structure of the infra-red absorption bands has been observed with considerable precision. This has been secured by modifying the older methods, increasing the resolving power of the dispersing apparatus and enhancing the

sensitivity and the control of the recording instrument.

The spectrometer consisted of two 30° prisms A and B of rocksalt. The one was fixed and the other could be rotated round a vertical axis and was mounted on the table LMNO. These two prisms were arranged in such a way that they acted as one at the position of the minimum deviation. To the table were also attached a concave mirror M_2 and a Hilger Thermo-electric Pile P. The radiations from a constant source (a Nernst Lamp) were made parallel by another concave mirror M_1 and after traversing the two prisms were concentrated by the mirror M_3 on the thermopile.

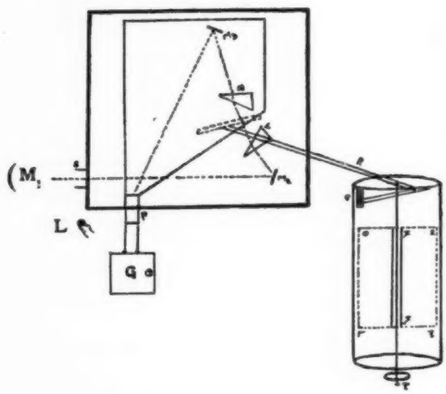

Fig. 1.

Self-Recording Spectrometer.

The recording instrument used was a Paschen Galvanometer with all the devices for protecting it from the external vibrations. Later on it was found that a Moll type galvanometer could conveniently be replaced with all the possible advantages. It was extraordinarily little disturbed by vibrations or external magnetic fields and its sensitivity was also found to be much higher than that of Broca type and about one-sixth of that of Paschen.

As in many self-recording instruments, the spot of light from the galvanometer traced a curve corresponding to the wave-length on an emulsion sensitive paper wrapped round a drum kept rotating by means of a small motor at a constant speed. The drum was also connected to the axle of the prism table by means of a lever arrangement RG. A 60° prism was found unsuitable for this work as a rotation of about 10° could turn all the rays out of the field.

The one conspicuous feature of the instrument was that it could obtain automatically and without the possibility of any personal error a photographic record of the absorption spectra in an appreciably short time.

The instrument before use was calibrated by means of some definite and known radiations. For this purpose the emission bands of CO_2 given by the Bunsen flame at $4 \cdot 32\mu$ and $4 \cdot 43\mu$ and those of other substances were used.

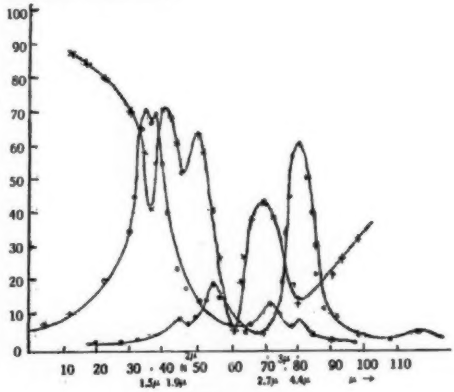

Fig. 2.

Calibration Curve.

× ×—Absorption Curve for Gypse.

•• Emission Curve for Gas (CO_2).

Two of the transmission curves of benzene and nitro-benzene are given in Figs. 3 and 4. Continuous and the dotted lines indi-

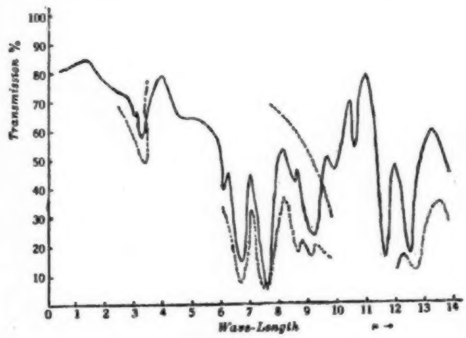

Fig. 3.

Benzene—C_6H_6.

$t = 0 \cdot 01, \cdot 02$ mm.

cate the different thicknesses of the cells used, which were 0·01 mm. and 0·02 mm. in the case of benzene and 0·014 and 0·02 mm. for

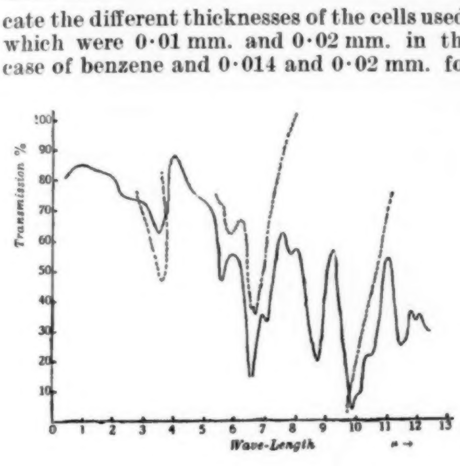

Fig. 4.

Nitro-Benzene—$C_6H_5NO_2$.
$t=0$; ·015 mm.

nitro-benzene. (They were calculated afterwards by direct measurements.)

The benzene spectrum showed a great transparency throughout the whole spectrum upto $14 \cdot 2\mu$ when it became suddenly opaque. The bands at $3 \cdot 25\mu$ and $6 \cdot 8\mu$ are to be noted very carefully as they occur in all the complex derivatives of benzene, and lead to the conclusion that the vibration of the benzene molecules is not destroyed.

The spectrum of nitro-benzene on the whole showed numerous and well-defined absorption bands. From the comparison of the curves for benzene and nitro-benzene it appears that the introduction of NO_2 group does not very much affect the benzene spectrum. Besides, there does not appear to be any other characteristic vibration due to this group, but there is a likelihood of $1 \cdot 15\mu$ band to be associated with it as this band is often found in all the spectra of the compounds having NO_2 group.

The other characteristic bands found from the curve were at $3 \cdot 3\mu$, $6 \cdot 25\mu$, $8 \cdot 6\mu$, $9 \cdot 85\mu$, and $11 \cdot 4\mu$.

A. P. MATHUR.

Bombay,
October 24, 1932.

Thermo-Hardening of Shellac.

SHELLAC and the Australian Acaroids, alone amongst the natural resins possess the property of thermo-hardening. This property is similar to the 'going-over' under heat exhibited by the phenol-formaldehyde class of synthetic resins, the commercial possibilities of which have been so energetically and successfully developed. The possibility of developing this property of shellac on similar lines has been investigated in this laboratory.

As a preliminary, a study was made of the factors influencing the time of heating required to 'cure' shellac. The possibility of considerably retarding or accelerating the process by additions of small quantities of certain materials has been established. These materials can apparently be classified into certain groups; *e.g.*, retarding substances include alkalis and solvents, while accelerators include acids, ester-forming catalysts, ammonia and ammonium liberating agents.

The effect of pressure was shown to be of great importance as it produces a very big retarding influence. This is a serious obstacle to the use of shellac as a moulding binder as the time of curing *in the press* is extremely long. It was found necessary to cool the mould before removal from the press and subsequently complete the cure at a low temperature, *i.e.*, about 80—90°C. Moulding prepared by this method, with addition of certain accelerators, have been shown to possess improved heat-resistant properties.

It is hoped that a paper will shortly be published describing the above work.

R. W. ALDIS.
S. RANGANATHAN.

Indian Lac Research Institute.
Namkum, Ranchi,
October 20, 1932.

Coronium Spectrum.

THE identification of the Coronium Spectrum with the spectrum of oxygen by T. L. de Bruin has evoked considerable interest recently in astrophysical circles, and in spite of the strong combinations which he has observed in the new terms of the oxygen spectrum, explaining some of the most important line of Corona, it must be admitted that the criticism of some of the very careful workers in the field of spectroscopy cannot be easily met. Theoretically there is no place for the new terms discovered by de Bruin. And with our past experience with the modern theory of spectra it is hard to believe that our present-day methods for calculating the spectroscopic terms are not materially correct. This, therefore, leaves

the question of the Coronium Spectrum still open.

We have during the last winter and summer attempted several times to excite the spectra of gases under a variety of conditions to look for the Coronium Spectrum. While it is difficult to say how far our experiments have been successful, we have observed a few facts which need recording. In all our discharge tubes when the pressure becomes very low, of the order of ·01 mm. or less and a powerful electrodeless discharge is passed, the whole visible region becomes practically free from lines, except for a few belonging to the secondary spectrum of hydrogen. As must have been observed by many, the production of these lines does not necessitate an external source of hydrogen supply and the minute traces of hydrogen evolved from the grease, etc., are enough to impart considerable intensity to them. One of these lines—one of the strongest in the secondary spectrum of hydrogen—is 5303·15 and another is 6375. We identify these lines with the two corresponding lines of Corona. There is *a priori* a strong case for the presence of hydrogen in the solar Corona, this being the lightest element, which, therefore, is expected to reach great heights. An examination of the spectroscopic data for the innermost transitions of most of the lightest elements on the basis of selection radiation pressure theory did not help us in any way except to strengthen the suggestion made here with regard to the presence of hydrogen.

The correspondence between 5303·15 and the coronal line is very close but the difficulty of the explanation of other lines still remains.

P. K. KICHLU.
B. M. ANAND.

Lahore,
October 31, 1932.

The Affinities of Chætognatha.

IN upholding the theory of the Annelidan ancestry of Chætognatha, Dr. John* attempts to explain the absence of a Trochophore stage in their development as due to the fact that they are pelagic. This explanation ignores the existence to-day of several pelagic forms (such as pelagic Mollusca and Crustacea) with a larval history. His analogy with the Oligochæta will not stand, for the Oligochæta have become so terrestrial that they do not go to water to lay their eggs and a free-swimming larval stage is not possible. Yet, even in them, a stage which can be compared to the free-swimming larvæ of other Annelids can be distinguished. The developing embryo bursts the vitelline membrane and floats in the albumen of the cocoon, feeding independently on it. A ring of delicate cilia surrounding the mouth and comparable to the prototroch has been distinguished in a species of *Lumbricus* and an adoral ciliated zone is recorded in the embryo of another genus (*Criodrilus.*) The embryos of the Oligochæta have in fact been described as degenerate larval forms.

S. G. MANAVALA RAMANUJAM.

Presidency College,
Madras.
November 1, 1932.

* *Current Science*, **1**, 66, 1932.

Studies in the Life-History of *Balanophora indica*.

THE study of *Balanophora indica* was undertaken three years ago with the object of working out the life-history, germination of the seed and its further development.

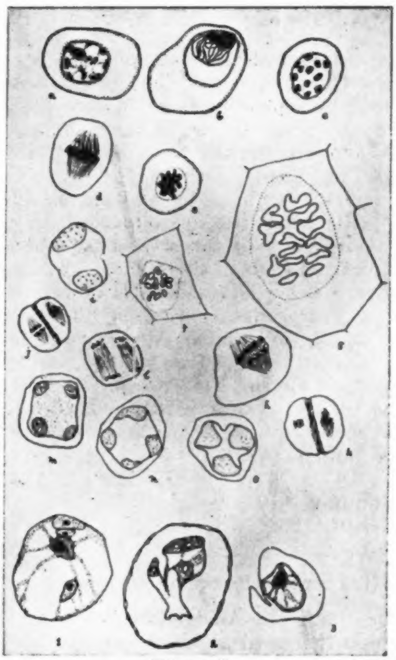

Plate I.

An account of the development of the embryo sac of *B. indica* was read before the Botany Section of the Indian Science Congress, 1932, held at Bangalore. The work carried out so far is briefly summarised below :—

The development of the megaspore-mother cell and the embryo sac has been followed

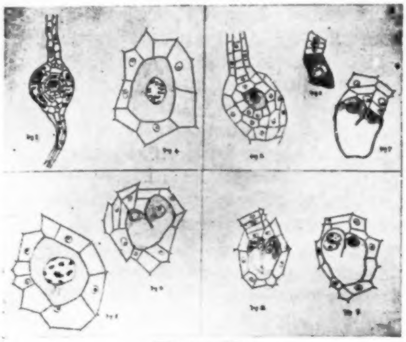

Plate II.

stage by stage (Plate I) and it closely resembles the description given by Lotsy[1] for *B. globosa*, except for the fact that the U-shaped embryo sac is rather broad with the two limbs being closely approximated. One noticeable feature is the presence of a row of three to four rectangular cells overlying the antipodal limb of the embryo sac, just the reverse in position of what Trube[2] has figured. Eight nucleated embryo sac is commonly found, the egg nucleus being not prominent. Several stages of the development of the endosperm and embryo have been observed (Plate II, Figs. 1, 2 and 3). No sign of pollen tube or fertilization has been noticed. Further study is in progress.

Regarding the microsporogenesis, the important features illustrated by figures (Pl. II, Fig. *a* to *o*) are stated here, the details being reserved for a comprehensive paper to appear elsewhere shortly. Microspore-mother cells are generally spherical in shape but some, however, retain their hexagonal outline. During meiosis, the nuclear membrane persists even after the diakenesis stage, disappearing only at the first metaphase stage. The chromosomes are short, thick and very small. At the metaphasic equatorial plate the chromosome number appears to be about sixteen. If this is confirmed by further observations, this number will coincide with that reported by Earnst[3] for *B. elongata*. Cell division by means of an incipient furrow is started at the end of the heterotypic division and does not progress further. In the second division the spindles are generally parallel but in some cases they are at right angles to each other. At the telophase and even later four groups of chromosomes can be noticed at the four corners of the mother cell, lying in the same plane. The formation of the daughter nuclei continues, leading generally to the the tetrad arrangement of the microspores.

L. N. RAO.

Department of Botany,
Central College, Bangalore,
September 1932.

[1] Lotsy, J. P., 1899. "Balanophora globosa Jungh," *Ann. du Jard. bot. de Buitenzorg*, Bd. 16.

[2] Trube, M., 1898. "Lorgane femelle et l'apogami du B. elongata," *Ann. du Jard. bot. de Buitenzorg*, Bd. 15.

[3] *Die zytologie der Blutenpflanzen*, 1926, p. 523, by P. N. Schurhoff.

Research Notes.

Width of the D Lines of Sodium in Absorption.

S. K. KORFF (*Astrophys. Jour.*, **76**, 124, 1932) has, by measurements on the D lines of sodium in absorption, shown that the contours indicate the theoretical variation of opacity with the inverse square of the wavelength distance from resonance and the variation of the width with the square root of the number of atoms in the line of sight. The conclusions are in agreement with the predictions of the radiation damping theory and also with the quantum mechanical theory of Weisskopf and Wigner. The experiment yields a new independent value for e^2/m as $(2{\cdot}51 \pm 0{\cdot}2) \times 10^8$, compared with the accepted value $2{\cdot}512 \times 10^8$. The effect of foreign gases on the width gives values of the effective "interaction radii" as 7×10^{-8} cm. for the Na-He combination and 2×10^{-7} cm. of Na-H_2, while Na-Na interaction radius is of the order of 10^{-6} cm. These results agree with the observations made in emission spectra of mercury arc in atmospheres of foreign gases by

Venkatesachar and Sibaiya (*Ind. Jour. Phys.*, **4**, 179, 1929) who state "that neutral normal atoms such as those of helium or normal molecules with negligible electric moment such as those of carbon-dioxide may be present inside the orbit of the optical electron without exercising appreciable influence on it. We, however, find when there is no admixture of a foreign gas in the mercury arc a pressure of 4 mms. has far more influence in not bringing out the higher members than a pressure of 40 mms. due to the introduction of carbon-dioxide." Korff's statement that hydrogen is far more effective than helium in broadening the line gives again the observation of Venkatesachar and Sibaiya that "When the arc is produced in hydrogen, a pressure of one centimetre produces the same effect in respect of widening the lines as a higher pressure say of 4 cm., when the surrounding gas is carbon-dioxide." The latter authors have also given the explanation for this observation. Korff has used 2·5 metre column of low density sodium vapour to make an approach to astrophysical conditions.

A Preliminary Note on the Development of *Rana tigrina*.

DR. M. L. SETHI, of Hoshiarpur, has made certain interesting observations on the extreme rapidity of cellular development and of the attainment of the larval stage of *Rana tigrina*. According to him, the frogs spawn in the early hours of the day during the breeding season, the morula stage is reached within an hour and a half after the eggs are laid; epibolic gastrulation, at the end of six and half hours: the neural plate and folds appear in about ten hours. The larvæ hatch out within twenty-four hours. This in his view is remarkable when compared with the developmental history of the English frog which takes usually a fortnight to reach corresponding larval stage. Dr. Sethi further mentions that the external gills appear within a day after hatching and hind-limbs sprout three days after and fore-limbs two days subsequent to this period. The metamorphosis is completed in thirty-eight days while in England frogs take from seventy-seven to eighty-eight days.

He further states that the development of a species of *Bufo* which inhabits Hoshiarpur area, the Punjab is on closely similar lines.

The Effect of Humidity on Supersonic Velocity in Air.

M. KINOSHITA AND C. ISHII have shown from thermodynamical considerations (*Tokyo. Sc. Papers.*, **19**, 83, 1932) the velocity V of waves, sonic or supersonic, in a real gas to be $V = \sqrt{p\beta\gamma/\rho\alpha}$ where p is the pressure, ρ the density, α the expansion coefficient, β the pressure coefficient and γ the ratio of specific heats. Considering both the air and the water vapour as real gases, the velocity in humid air becomes

$$V_h = V_1\,(1+0\cdot000210e)$$

where V_1 is the velocity in dry air and e the vapour pressure in mms. of mercury. Using a valve oscillator for exciting oscillations in a rectangular quartz plate of Curie-cut and a thermohygrostat, the authors have obtained results in the supersonic range which can be expressed by

$$V_h = V_1\,\{1+(\cdot00023 \pm \cdot00001)\,e\}$$

In conclusion they draw attention to the applicability of this relation to practical hygrometry. The advantage over all other hygrometric devices consists in the possibility of measuring the humidity in any limited space without disturbing the condition of the air in the enclosure.

The Chromosome Number in Sphenodon.

R. D. KEENAN has given an account of the chromosomes in Sphenodon Punctatum (*Journ. Anat.* 1932). According to him, "the number of chromosomes in the spermatogonia of *Sphenodon* is 36, *i.e.*, 12 V- or J- shaped, 16 rods, two very short rods and 2 micro-chromosomes. The equatorial metaphase plate of the first division shows 18 tetrads, 6 of which have an atelomitic attachment of the spindle fibre and the remainder a telomitic attachment. The atelomitic tetrads are similar in structure to the anaschistic V-shaped tetrads of other Reptilia and also to the ring tetrads of the Orthoptera. The telomitic tetrads usually appear as equatorial rings. Secondary spermatocytes were rare but one observation on the second division at anaphase showed clearly the presence of 18 elements, *i.e.*, 6 V-shaped, 9 rod-shaped and 3 dot like. From the observations made, it is highly probable that the male is homozygous in respect to sex, the condition of the chromosomes being XX. Applying the theory of Robertson concerning the formation of V-shaped chromosomes to those of sphenodon, it is possible that the

primitive number of chromosomes in the reptilian order is 48. It is suggested that the chromosomal formula of the Autosauri has been derived from this primitive number principally by a reduction in the size of the individual elements."

Study of Mountain Structures.

"THE Application of Mechanical Structural Principles in the Western Alps" forms the subject of an interesting paper by Andrew Leith recently published in the *Journal of Geology*, Vol. IX, **39**, 1931). After giving a brief review of the generally accepted hypothesis regarding the origin of the Alps based on stratigraphic, lithologic and palæogeographic evidences, the author states that there is generally a complete neglect, in these hypotheses, of mechanical structural factors. The need for employing such evidence in the elucidation of obscure problems of Alpine structure is emphasized and numerous examples are given where the author has applied such mechanical structural evidence successfully in the "Hautes Alpes Calcaires" of the Western Alps.

Histology of the phloem necrosis of Potato.

"A STUDY of the histological changes resulting from certain virus infections of the Potato" forms the subject of a well-presented paper, recently published (*Proc. Roy. Soc.*, Ser. B., **3**, No. 769) by F. C. Bawden. After giving a brief reference to the previous works on the subject from 1913, the author gives a short description of the anatomy of the healthy stem of potato with its isolated groups of inner phloem and the outer phloem which becomes linked up with the formation of the secondary phloem. In the mature plant there is a considerable amount of secondary phloem. The wall of the sieve tubes sometimes becomes slightly thickened with cellulose but shows no pathological changes. The author agrees with Quanjer's division of the Streak Disease into two main groups, *e.g.*, Acronecrosis or Top-Necrosis and Acropetal Necrosis or Leaf Drop Streak. In top necrosis, necrotic spotting of the upper leaves followed by the dying of the plant from top downwards form the main external feature. Internal symptoms are started in the petioles, stem and tubers and consists of necrotic changes in the phloem. In the tubers and stems grown at high temperatures, phellogens are formed round the necrotic areas. The external symptoms of Acropetal Necrosis are crinkling of the upper leaves, necrosis and falling of the lower leaves. Internal symptom consists of necrosis affecting chiefly the collenchyma as seen generally in the stem and petioles. The necroses are produced in the phloem of plants suffering from leaf-roll in the year following that of infection and are restricted to the phloem elements and consists in lignification. No necroses were found in the virus free stem or petiole.

The Menstrual Cycle of the Primates.

THE fifth part of this very important series of papers on the "Menstrual Cycle in the Baboon" by Dr. S. Zuckerman and Dr. A. S. Parkes (*Proc. Zoo. Soc.*, 1932, Part I) embodies the results of an investigation into the morphological changes in the reproductive cycle of the female baboon as evidenced by an examination of twenty-one specimens of both species, *Papio hamadryas* and *P. porcarius*. The cyclical changes are essentially the same in the two, except for the greater size of the non-pregnant uterus in the Chacma species (*P. porcarius*)—which in all probability can be accounted for by the larger size of the animal itself—and its deeper endometrium. An examination of the general morphology of the reproductive organs reveals that the baboon corresponds to the type found in the Old World apes and monkeys. During the course of the cycle the region surrounding the anus and the external genitalia swells to form the "sexual skin", which, undergoing cyclical changes itself, acts as an excellent external indication of the very complicated internal phenomena. Its history can be said to begin soon after menstruation has set in, when it swells very soon attaining a maximum size. Suddenly, however, it is seen to subside and become quiescent. This coincides with the rupture of a ripe Graafian follicle. The skin remains in this condition till the onset of the next menstrual bleeding.

The ripe Graafian follicle of the baboon is quite large, the largest measuring over 6 mm. in average diameter. It is noticed that the history of the growth of the follicle can be divided into two phases: first, when the oocyte and the follicle grow together and subsequently, when the ovum ceases to grow while the follicle continues to. As soon as the ovum is extruded, along with a

large quantity of liquor folliculi, the thecæ rupture and their tongues project into the ruptured follicle dividing it into lobes. By this time the granulosa cells are slowly being transformed into luteal cells. The rupture of the follicle which is coincident with the subsidence of the sexual skin at once initiates the formation of the corpus luteum and three days later it is seen to be definitely formed. Very soon and very rapidly, however, it degenerates and, by the time the next luteal phase is established, it is hard to be distinguished. The history of the corpus luteum in the pregnant animal, on the other hand, has not been worked out so thoroughly, due, probably to lack of material. It is, however, noticed that the corpus luteum of pregnancy is the largest in the entire cycle; but it is not known when the degeneration of the corpus luteum of pregnancy takes place.

Menstruation in the baboon consists of a destruction of the outer two-thirds of the endometrium accompanied by profuse bleeding. The ruptured glands and their secretion, clumps of stromal cells and patches of surface epithelium constitute the debris. There does not, however, seem to be any uniformity in this isolation of the uterine epithelium and a part of its underlying endometrium, for different regions of the uterus are involved at different times and in different degrees. First the stroma is destroyed and the glands are affected later, consequent on the sequestration of the tissue in which they are lodged. Very early in the follicular phase the endometrium is regenerated. Though the exact nature of this regeneration process has not been ascertained, it is certain that even in the later stages of the menstrual process the surface epithelium is restored everywhere. The glands are straight, long and tubular and there is no secretion in their lumen. The regeneration of the endometrium continues during the ensuing luteal phase when the stroma becomes oedematous and the glands are extremely long, coiled and distended with secretion. The changes that occur in the uterus after parturition are not found to be very different from those in the uterus of the common macaque and man. During this phase the endometrium is very shallow and the ovaries inactive. The presence, in this stage, of a large quantity of debris in the uterus of the nursing animal has not been accounted for, unless it is assumed that a degeneration of the endometrium and the myometrium takes place during nursing.

The vagina in the non-pregnant animal has a greatly thickened and keratinized epithelium. During the luteal phase the cell layers are gradually sloughed off till at the beginning of menstruation the ragged surface left by the desquammation is repaired and the epithelium consists of a thin layer. During menstruation again the vaginal epithelium is thickened and cornified. This continues through the follicular phase leading to the typical corrugated epithelium seen just before ovulation. During pregnancy, especially during its later stages, large mucin cells are seen to develop in the crypts of the vagina. After parturition the vagina lapses into a state of inactivity.

In the non-pregnant animal there is little change observed in the mammary glands. In fact their functional activity starts from the moment of parturition but they atrophy if suckling is discontinued. Available evidence makes it possible to believe that the mammary glands are permanently active.

A Scheme for Advancing Scientific Research in India.

By P. W. Gideon, *Karnatak College, Dharwar.*

SCIENTIFIC research in this country is comparatively young, and it is unfortunate that when India has just begun to encourage research of definite economic value there should be a setback in the form of financial stringency. As a result, valuable research work in Agriculture and Medicine, which has brought definite material prosperity to the country is likely to suffer, unless some scheme is devised for still encouraging and financing such work. The following is a suggestion put forward in the hope that, not only those who are engaged in research, but also those who are interested in the economic value of the results of such research, will do all in their power to encourage such work in India.

The majority of colleges teaching Science in India are really free centres for research, having trained men with leisure for such work, and well-equipped laboratories at their disposal. Might not a request be made to the Government of India that they invite, through Provincial and State Governments, the services of these men to work on research problems which have a direct economic value from the Agricultural, Medical, and Veterinary points of view? Most colleges teaching the science courses for the I.Sc. and B.Sc. examinations have laboratories equipped for research purposes and the majority of the members of the staff are expected to interest themselves in research work. The

average number of hours of work for those teaching up to the B.Sc. standard is 12—15 per week, and for those teaching up to the I.Sc. standard 10—12 per week. The men appointed as Professors, Lecturers and Demonstrators in these colleges are trained in research methods, and eagerly take up teaching as a profession because of the prospect of continuing research in the subjects in which they are interested. There are, however, instances of men, who for want of sufficient encouragement (chiefly financial), are forced to content themselves with the ordinary daily routine expected of them as mere teachers.

With such excellent material, equipment and personnel at their disposal, it is a matter for regret that the free services of these trained men and their well-equipped laboratories have not been sufficiently exploited by the Government of India in the solution of problems of value to the Agricultural, Medical, and other departments.

The majority of these trained men are utilizing their spare time in doing valuable work of a purely academic nature in every branch of science. Leaving this type of work to the great University centres, the present scheme would organize the other trained men scattered in colleges all over India, so that their methods of research could be utilized on problems of economic value to the country. So far this side of research has been left to a very small section of scientific men in India, working in recognized research centres.

In the Bombay Presidency there are at least 16 colleges teaching science. Leaving the Royal Institute of Science in Bombay to carry on research work from the academic point of view, the remaining 15 colleges are admirably situated in very important areas and would form excellent centres for research. No doubt the same would apply to colleges in other Presidencies, Provinces and States.

Such a scheme would mean that mofussil colleges would play a very important part since being few and far between they would have to deal with comparatively large areas abounding in problems which must be studied in their natural surroundings. In such inexpensive centres of research, supplemented by comparatively small annual grants for the purchase of literature and apparatus suitable for the particular problem undertaken, important investigations might be carried out and desired results obtained, whereas otherwise, these problems might remain unsolved for want of large sums of money for the erection of special research buildings, the employment of special staff and the purchase of special apparatus.

As regards the trained men available, there are in each science college at least three departments useful for purposes of economic research, —the departments of Zoology, Botany, and Chemistry. In Intermediate Colleges of Science there are at least four men available for such work, and in colleges teaching the degree classes at least three men in each subject are available.

The fact that the Imperial Council for Agricultural Research allots a certain amount of money as research grants to various trained men in colleges proves the value of the work done by these men. In the present state of economic distress it would appear that much of this valuable work would have to be stopped. The scheme now outlined would enable this research work to be continued on a more intensive basis and with practically no additional cost to Government.

Keeping in view the necessity for retrenchment and strict economy in expenditure, and at the same time the need for increasing the revenue of the country, it might be in the interest of Government to consider the proposal as follows :—

Create a central board consisting of representatives of the Educational, Agricultural, Medical and Veterinary departments of the Government of India, which will

1. Invite Provincial Governments and the Governments of Indian States to co-operate in the economic progress of the country by :
   (*a*) ascertaining from all Government and Private Institutions teaching Science, the number of men willing to carry out original investigations of a definite economic value, together with particulars regarding the branches of study in which they have specialized,
   (*b*) classifying these specialists as under Protozoology, Entomology, Plant Pathology, etc.

2. Invite all Central and Provincial Agricultural, Medical and other departments to submit important problems, which they have not been able to undertake for lack of money, but which in their opinion if investigated, would mean a definite gain.

3. Classify these problems :
   (*a*) Scientifically, as under Zoology, Botany, Chemistry, and their sub-divisions.
   (*b*) Geographically, so that colleges nearest to the affected areas be invited to undertake the investigations.

4. (*a*) Calcuate the approximate annual grants that may be required for carrying out these investigations in such colleges as are willing to help.
   (*b*) Ascertain the amount of money each department (Agricultural, Medical, etc.) would contribute towards the investigations suggested by them.
   (*c*) Invite contributions from commercial bodies who would benefit by such investigations.

5. Consider the desirability of asking Universities to recognize such centres of research for post-graduate work, so that members of the staff engaged on such problems may take the free services of students to help in the investigations, and on the strength of such work students may be allowed to submit theses for the M.Sc. degree. Such a system will not only solve the problem of employing paid assistants, but also will be producing University men trained in research methods of a definite economic value.

6. Consider the desirability of closing down smaller research establishments, and retrenching in bigger research centres such problems as can be investigated on a cheaper and yet as

efficient a basis in the various college research centres. A very small proportion of the money thus saved could be distributed as small annual grants to those undertaking problems in science colleges.

7. Invite recognized research bodies like :
   (a) The Imperial Council for Agricultural Research,
   (b) The Zoological and Botanical Surveys of India,
   (c) The Imperial Forest College,
   (b) The Indian Central Cotton Committee,
   (e) The Indian Science Congress,
   (f) The Indian Medical Council,
   (g) The Imperial and Provincial Agricultural Research Institutions, and other scientific bodies to co-operate by giving such help (financial or otherwise) as would enable the Central Government to formulate a scheme of work as would effectively cope with the present needs of the country.

Such a co-ordinated effort for carrying on an intensive research from an economic point of view will mean not only less money spent on research work but also added interest to so many trained men whose energy, training and time have hitherto not been utilized. This scheme would be within the strictest bounds of economy and would produce results of immense importance to the economic development of India.

A Marine Biological Station for India.*

By C. Amirthalingam, B.Sc. (Lond.), Ph.D. (Lond.),
Late Research Officer, Andaman Fisheries.

THERE is no doubt whatever that Marine Biological Stations in India are essential for advancement of Science and its successor, the economic exploitation of the sea. At the present time, there are facilities for marine research in the University of Madras and in the Madras Fisheries Department. As there are already places on the East Coast for research as such, one on the West Coast will be a great asset. As regards the centre, it may be said that Bombay is one of the suitable places, although in 1926, Col. Sewell initiated a five-year plan for the Zoological Survey of India, in which a Marine Biological Station was to be established in Karachi, but which was temporarily suspended due to financial reasons.

Among the problems that a station such as this will take up, will be the whole question of suitable methods of obtaining the maximum catch with the minimum cost of money and energy as it is not safe to assume that the appliances used in the West will be equally successful in Indian Waters. Thus, there is every possibility that great improvements will be made in the methods employed by our fishermen to-day. One has to look at Japan to know what great scope there is to develop the marine resources on Western lines to suit local conditions.

The value of the fisheries will depend not only on the quantity of fish caught but also on the quantity sold fresh or preserved for food and on the by-products such as oil, fishmeal for manure, etc. Hence *pari passu* with the improvement of fishing methods, marketing facilities, etc., must be developed, on the lines similar to those of the Madras Fisheries Department.

There is one important suggestion worth considering and that is the economic research must have a pure scientific basis. This will be best achieved if both the scientific and economic sides of the question are studied by *different* officers in the same biological station, thus ensuring a healthy co-operation and free exchange of ideas. The importance of this is borne out by the fact that fishery work has been carried on in Madras for about twenty-five years, but little research as such has been accomplished, as the time of its officers has been absorbed by administrative duties: in spite of this handicap the department has collected some valuable data and obtained good results.

The importance of knowing the bionomics of the animals is emphasized by Dr. Setna himself who states, "Our fishermen—and even we people with scientific training—know practically next to nothing of the migratory instincts of the fishes, etc." Here, one should not forget that data will be needed not only on the study of fishes with reference to the breeding season, rate of growth, food supply, and other factors but also on the questions of salinity, temperature, chemical composition, and movements of the water mass that wash the Indian Coast *at all seasons of the year.*

Further in a marine station, facilities will exist to work out in detail the morphology of the common animals to provide the necessary books for teaching. It is this want of text-books, dealing with Indian types, that is mainly responsible for the deplorable state of affairs as stated by Dr. Setna regarding specimens from Europe. Here one may refer to the fact that the essence of teaching science is not to cram the student with a mass of facts but to develop the powers of observation and logical deduction and text-books are to serve as mere guides to the student. Thus as the text-books used in various colleges are those dealing with European species, the institutions had to resort to importing specimens for the class-rooms. This number will die a natural death when a few more custom appear of the series entitled "The Indian Zoological Memoirs" which was initiated and is edited by Prof. Bahl.

As Dr. Setna suggests "the income of the station will be derived from (1) admission charges to the aquarium, (2) supply of marine specimens to places inland, (3) rental of tables"; it is submitted that the last item should be kept as low as possible for individual workers and especially the under-graduate, as it is not advisable to increase the cost of training; whereas

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* *Cur. Sc.*, **1**, 108, 1932

institutions may be approached to contribute annually towards the upkeep of any particular table.

In conclusion, the importance of the establishment of a Marine Biological Station in Bombay cannot be over-emphasized and special attention is to be paid to scientific research as a basis for economic exploitation of the Indian Waters.

The British Association—York Meeting, 1932.

THE Presidential Address of Sir Alfred Ewing at the York Meeting of the British Association is a very human document. Full of years and honour, Sir Alfred has known the Association almost from its very inception and gives a graphic account of the early days and the state of science then, contrasting it with the present conditions and outlook. He shows how a proud sense of scientific certainty has given place to a more humble, questioning spirit which recognizes that we are yet groping very much in the dark and that "to understand is to draw one incomprehensible from another incomprehensible" as Einstein put it. This humility has brought science nearer to the layman who shares in the desire for truth ; the social and economic problems of the day make him look wistfully to science for a satisfactory solution. The British Association has helped the advance of science by providing a common meeting ground for experts in different branches of science and Sir Ewing gives a famous instance of this in the fruitful association it brought about between Joule and Thomson. He also shows how the British Association was the first to try and give a sound scientific basis to British Engineering practice, mostly empirical before. The standardization of electrical units is another of its services.

After mentioning the most recent advances in our knowledge of nuclear structure due to the work of Chadwick and Cockcroft and Walton, Sir Alfred Ewing passes in review the many wonderful inventions whose birth he has witnessed, such as the dynamo, the motor, the internal combustion engine, the aeroplane and airship, the turbine, the gramophone and wireless. He emphasizes that modern invention has had such rapid progress because it built upon sure scientific knowledge and not on accidental discovery. This rapid increase of inventions has brought many amenities to the lives of men, but the consequent change in the methods of production and distribution has also upset the balance of human relations so that unemployment, competition and war have become a standing menace. Sir Ewing rightly concludes by a note of warning against allowing such a condition to develop ; as he says, we can only hope that man will not encompass his own destruction by wrong application of his God-given understanding, but that science will help him to enjoy the luxuries which science creates, in a manner leading to the elevation of his soul.

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The Presidential Address to the Section of Mathematical and Physical Sciences deals with the application of physics to a problem of economic and national importance, namely, the discovery of valuable deposits such as minerals or oil, without actual digging or boring. It is a subject which, for its development, requires the co-operation of physics and geology, involves team-work in the field and is costly to pursue. Yet judicial application of the methods developed by workers in this field often leads to a considerable decrease in relative costs, and further improvements may in future lead to greater reliability and cheapness. Being an infant science which cannot attract public attention through sensational discoveries such as are being made in atomic physics, it is likely to languish for want of support: Prof. Rankine justly emphasizes the need for Government help at such a critical stage of its life. Leaving aside such appliances as the divining rod, whose action, even if real, is not based on known scientific principles, the methods at present available are four, *viz.*, gravitational, seismic, magnetic and electrical. In the first method, the extremely sensitive torsion balance invented by Baron von Eötvös, is used to study the variations in gravity due to variations of the density when layers of different minerals are present in any locality. The instrument though costly, is very reliable, and its indications will lead to valuable results, unless topographical irregularities are so large as to mask the effect of mineral deposits. The seismic method is particularly suitable when there is a horizontal separating layer between two extensive deposits in the lower of which the seismic wave travels faster than in the upper. In such a case the disturbance due to an explosion travels to the separating layer and being refracted or diffracted along this, reaches the surface at a large distance earlier than the direct pulse travelling along the upper deposit. Hence a delicate portable seismograph will be able to record it so that it is not masked by the larger perturbations due to the direct wave. When iron-bearing deposits are concerned, the magnetic method, which depends on measuring the variations of the horizontal and vertical components of the Earth's magnetic field by means of a portable magnetometer, is most suited and is least costly. The method will be even more useful when the magnetometer is improved as suggested by Prof. Rankine by utilizing the torsion principle used in the Eötvös balance and thus making it more sensitive and at the same time less liable to disturbances due to daily and temperature variations of the magnetic field. The possibilities of the electric method, in which the variations in the electrical conductivity of different layers are measured, have not yet been fully explored. In fact, the method was shrouded in mystery before the publication of the Report of the Imperial Geophysical Experimental Survey. But in future, when other nations besides the Germans, who have so far been almost the sole cultivators of this science, devote their attention to the problems of Geophysics, the electric and other methods may confidently be expected to be enormously improved and the science firmly established among other branches of applied physics.

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In his presidential address to the Section of Agriculture Prof. R. G. White gives a succinct history of the growth of Sheep Farming in England. From very early times, dating as far back as the Norman conquest, sheep farming has always remained a substantial source of the British farmer's agricultural income and statistics for the year 1930 show that except for New Zealand, Great Britain holds the eighth rank in the sheep population of the world and a third of the world's sheep are from the British Empire.

The importance of sheep farming is no new feature of British Agriculture. Throughout the middle ages and upto the middle of the fifteenth century, England was the most important source of the supply of wool required by the continental manufacturers. The export duties levied on these outgoing supplies were among the most important sources of revenue available for the mediæval equivalent of the present Chancellor of Exchequer. The industry received a definite stimulus by the various enactments which prohibited the export of wool with a view to have all the British wool for the British looms. Legislation was not the only means to foster woollen manufacture. Definite encouragement and attractive inducements were offered for foreign weavers, particularly Flemish, to come and settle in different parts of England.

The development of woollen manufacture, the consequent heavy demand for wool and the increase in the industrial population contributed not a little towards the rapid strides in the agriculture of the country, particularly sheep farming. To meet the growing demand for wool and to provide food for the growing industrial population, the population of sheep had to be increased which brought in its train the necessity for converting arable land into sheep pastures and the development of mountain sheep farming.

Discussing the present status of the sheep industry in England, Professor White suggests directions in which the future developments are possible. His first suggestion is to increase the return per unit of flock, particularly when England has to depend for its supply of meat from January to May on outside countries. He further suggests methods to make better use of the ewe's capabilities of production by an increase in the lamb crop. With some more useful and economic suggestions for the improvement of sheep farming in England, the President makes a definite case for regarding sheep farming as a distinctive feature of British Agriculture.

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Lord Rothschild in his Presidential Address, makes out a very vigorous case for the Systematic Biologist whose work, unlike the common prevalent notion, is really one of great difficulty yielding results of equally great importance. Applied Biology would be helpless without the assistance which Systematic Zoology constantly renders it. The identification and distinction of species is a matter of paramount importance, for not only structural differences are implied in such a distinction but differences in their behaviour as well. It should not be forgotten that it was a systematist that made the very important discovery that while *Xenopsylla cheopis* is the rat flea that carries plague, the allied *X. astia* is a very inefficient carrier of the disease. The bearing of this distinction on the determination of the history of the disease was found to be very close.

The work of the systematist does not merely consist of a study of species and their varieties only. The grouping of species "into genera and then into higher categories, all according to relationship" is the more important part of his work. He must enter upon Geography also throwing light on the affinities of species and genera with regard to their Geographical distribution. He must take into account ancient forms and must be able to determine their relationship with the History of the Earth. Though the systematist is more concerned with the organisms produced by Nature than with the active forces that created or evolved them, for a definite and real understanding of the diverse processes going on in Nature, the systematist with his large collections of organisms and his expert knowledge at the grouping and determination of these organisms into their different classes is of inestimable value.

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In his Presidential Address to the Section of Archæology, David Randall MacIver says that the advent of the science of archæology in England is almost contemporaneous with the announcement of the "Origin of Species" by Darwin and Wallace. It was in 1850, a few years prior to this great epoch-making discovery, the subject of Archæology was founded and in the succeeding years definite steps were taken to unravel the hidden mysteries. It is usually accepted that the scientific aspect of this interesting subject drew its inspiration from the subject of antiquary, and like anthropology, archæology is a very young science both of them being closely allied. They deal with man, but from different aspects. Anthropology which is the wider of the two deals not only with "man's material works but also his mental, moral and sociological developments", while the "interests of archæology is solely in those works which can only be produced by man when he has become more or less sapiens". This is rather a conservative definition, for certain remains of flints antidate any actually known remains of man,—the researches of this science extending as far back as the tertiary. After that it is only about 3500 B.C. that inscriptions and documentary evidences are found. The organization of the subject consists in the collection of the material, conservation and exhibition and then popularizing it. For the collection of material an able body of scientists with the consent of Government authorize an expert to be in sole charge of an expedition. As soon as the exploration is over a publication incorporating the various aspects of the exploration must be made in a suitable manner. The findings must be properly arranged and exhibited in a museum. Such a scientific collection need not be further amplified by decorations. Having described these aspects of archæology the President discusses in a lucid manner the principal problems like the application of a time scale and the dissemination of a culture. A relative chronology has been established from earliest times and these culture periods require proper definition in terms of years. Thus the products of Egyptian civilization have been dated and with reference to this the others are measured.

In his Presidential Address before the Botany Section, Prof. J. H. Priestly laid stress on the importance of the botanical study of trees which do not receive adequate attention from the botanists. Trees do not form a special botanical category, but they are often regarded as the special study of the forester rather than the botanist. Utilitarian side gave the first impetus to the scientific study of botany and botany still finds in agriculture and forestry its contribution to make in the service of mankind. He felt that the recognition of this practical significance would vitalize botanical teaching. He agreed with I. B. Balfour that the study of growing trees throws fresh light upon its form, structure and vital functions and gives new meaning to the practice of the forester and horticulturist whilst details of structure which attract the attention of the worker in wood are also seen in new perspective. The tree is characterized by prolonged vegetative growth and delayed reproduction. In the growing season growth takes place radially in the woody axis and in length in all the branches. These two are not separate functions but are inseparably and casually connected. In dicotyledons and gymnosperms growth process continues to thicken the axis after it has extended in length. The address gives a detailed account of the shoot apex, the development of the leaf primordia, the vascular connection with that of the axis, the formation of the cambium, and its continuity with the apical meristem of the basipital cambial activity from the buds suggested by Hartig so long ago as 1862, along with its practical bearing in forestry and horticulture. The varied details of this phenomenon have proved exceedingly interesting and there is no doubt that the new technique followed to study the above process has much to tell us of the characteristic of the radial growth in different trees like the ring-porous type and diffuse-porous type of woods of oak and beech respectively. Further, the fact that the tree-form and structure is dominated by this causal link between bud development and radial growth has been very well treated with common examples. The subject of vascular differentiation in the soft and hard woods has been dealt with in detail. As the cambium cylinder grows wider the relative readjustment of position in the cambial cells takes place by "Symplastic" movement of the common frame work of walls of the fusiform initials. Then the surface of the wood comes to be clothed throughout its entire length with a new layer of wood which originates and spreads from the base of the extending foliage shoots. If the buds on the lower branches fail to grow, cambial activity also fails in these branches. It is from this point of view, the movement of food and water in the tree must be interpreted. Water movement through the tree is associated with the growth of the tree. The mechanism of movement is inseparable from the process of growth and differentiation, and the movement is not equivalent to the passive flow of water, the sap wood acting as a reservoir of water. So long as the cambium is still growing, the downward movement of organic materials in the tree must be clearly connected with those growth processes. There is very general agreement that the phloem plays a role in this movement. It may be that subsequently in fully differentiated sieve tubes, companion cells, etc., translocation of food still takes place, but on the other hand, the structural features of the adult sieve tube may rather be analogous to those features in a dry river bed which supply evidence that it was once a channel for rapid flow of current. These statements show that the intriguing problems of the growing tree are not only of interest to the students of science but also of profit to the forester and the horticulturist. When we see the wooden materials fashioned to our service which surround us on every hand, a knowledge of the story of the way in which they came into being will surely add to our pleasure in them.

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In his Presidential Address to Section C. (Geology) Prof. P. G. H. Boswell has given an admirable account of the relationship of early Man to well-established geological phenomena in the Ice Age—a very fascinating field of study on the border line of Geology and Archæology. The earlier part of his address deals with the intrinsic value of a study of the subject of Geology and the position which this subject should occupy in any curricula of studies in our schools and colleges. It is needless to say that, coming from such an eminent educationist and well-known geologist, these ideas are worthy of serious consideration by all people interested in the cause of true education. "For the breadth of view which it engenders and the enthusiasm it inspires", Prof. Boswell considers that Geology ought to find a place in the curriculum of every university student (as it used to in the Royal College of Science and still does in at least one American university)—a view that has been even more emphatically expressed recently by the Prime Minister when he said: "If any one of the sciences were selected as the key to all the other sciences, as that which in its subject-matter and its history, the history of its evolution, enforces the true scientific method, Geology might be selected as that science. For it touches all the fundmental sciences; it teaches the young how things become, how age merges into age, how species merge into species, how generation merges into generation, institution into institution—in short, how to approach that problem of a working and progressive society by making them acquainted with the processes of earth structure and of life lived on that structure."

Out of the several contacts of Geology with other sciences, Prof. Boswell's address on the "Ice Age and Early Man in Britain" deals with field where Geology is able to help in the spirit of pure investigation, without any practical applications or utilitarian reward. In the light of recent evidences, it is obvious that the older idea of the advent of Man on the earth's surface being considered a post-glacial phenomenon must be abandoned, and we must realize that Man was a contemporary of the mammoth and the straight-tusked elephant of glacial and inter-glacial times. It must, therefore, be possible to co-ordinate the evidence of Man's activities with that of the advance and retreat of the glaciers; and it is with this interesting subject that Prof. Boswell's address essentially deals. For this purpose he has selected a number of areas in Britain where a thorough investigation of post-tertiary geology has furnished evidences for the contact of early Man with stratigraphical horizons. He begins with East Anglia where

he considers we get the standard succession of glacial and other deposits associated with the remains of early Man. Other areas like Lincolnshire, Yorkshire, Northumberland and Lake District, the Irish sea and Cheshire basin, the Avon-Stour area, and the Upper and Lower Thames are next considered, and in each case, a very detailed account has been given of the several horizons of deposits in their stratigraphical order, together with the nature of the associated stone implements. Most of this descriptive account of local geology will be considered rather dull reading by the average layman, although to the serious student of the evolution of early Man, the wealth of information embodied in these descriptions is of utmost interest and value. An attempt at correlating the observations made in these different areas so far as Britain is concerned, has been made and the author feels that it is impossible to go any further in this line of work for "it would be premature to attempt world-wide correlations of the geological and climatic phenomena accompanying human industries". A fact of general interest that emerges from these studies is that according to Prof. Boswell "whatever the cradle of Man may have been, Asia or Africa, the evidence of prehistoric stations shows that the waves of his successive migrations advanced north-westwards across Europe. * * * His advance was determined by the extent to which the country was ice free; for we find that successive human industries extend farther northwards and north-westwards as the ice retreated, although the readvances of the glaciers and flooding of the country temporarily drove the invader back." By studying the several areas in the particular order which he has followed Prof. Boswell has shown that the sequence of human industries—pre-Chellian, Chellian, Acheulian, Mousterian, Aurignacian, Solutrian, Magdalenian, Tardenoisian, and Neolithic when traced north-westwards across England display, as must be expected, the phenomena known to geologists as overlap "the newer deposits and human waves would extend farther than the older, as the area was opened up by the retreat of the ice."

In view of the fact that the field covered by the address is one in which pioneer work is still being done, there is no doubt that an address like the present one embodying all the recent work carried out in a country which has provided exceptionally valuable information in the study of early Man, will be of very great value to all future workers in this line.

Two Convocation Addresses.

MYSORE UNIVERSITY.

DEWAN BAHADUR SIR C. V. KUMARASWAMY SASTRY'S Address, delivered last month at the Convocation of the Mysore University, is in several respects an important and interesting public utterance on some of the Educational topics which are usually omitted on such occasions. It is true that, as is common to all Convocation addresses, there is in this also a fairly generous appeal to the graduates to develop their character, to maintain their religion and morals and not to forget their own language and the glorious heritage of India. But so far no one has had the candour to dwell on and vindicate the eminent learning and usefulness of the Pandits, who, on the other hand, are generally condemned, chiefly through prejudice and ignorance. Sir Kumaraswamy Sastry is a conservative by constitution and in the course of his long public service, has developed a cautious attitude towards all public questions. But his condemnation of the uneducational practice of frequently changing the text-books in the different grades of instruction whose character and content provide neither information nor intellectual discipline, is at once refreshing and timely. He pleads with the ability and skill of an advocate, the cause of the poor and middle-class students who, on account of the excessive cost of education, are unable to participate in its advantages. But by far the boldest utterance in the address relates to the utterly stupid curriculum of studies pursued by Indian women students. His views on the ideals of womanhood apparently belong to a bygone age and he has no sympathy with those who advocate equality and liberty for women. His reference to the failure of scientific education to promote peace and goodwill among men is, we are sorry to be obliged to say, proceeds from an inadequate conception of the purpose and ideals of science. Science ought not to pretend to promote human happiness or to destroy it though its results might be used or prostituted for either purpose; but its main ideal is to give its votary a strict discipline of truth and open out new visions of the ultimate reality. In spite of a certain lack of what critics might call modernism in the views of Sir Kumaraswamy Sastry, on some major questions of education, the address taken as a whole, is a most notable pronouncement.

M. S. M.

THE ANNAMALAI UNIVERSITY.

The Second Convocation Address of the Annamalai University was given on the 27th October by Mr. R. Littlehailes, Director of Public Instruction in Madras. It may be said at once that it is a clear pronouncement on some of the subjects with which he has dealt. He says, "I could considerably expand this (the old educational policy) as well as other aspects of educational administration, but I do not consider the present to be either the time or occasion to develop at length views on education in India." If, instead of imposing upon himself the self-denying ordinance, he had pursued the course of his natural impulse to expound the progress of education and achievements of his department, we should doubtless have gathered much valuable and authoritative information. Everyone who is interested in the growth and expansion of education and the output of the right type of men from the educational institutions, will be grateful to Mr. Littlehailes for calling public

attention to the fact that the role of parents in the education and development of character of their children is far more real and earnest than that of teachers, and for properly exercising this most important function, the atmosphere of students' home must be cultured and elevated. Dealing with that much-abused termo, "democratisation", he clears the prevailing confusion of thought in the public mind and points out that democratisation of education is good in the interests of the community and democratisation of the department of education and of the Universities is fraught with danger to both. One will readily agree with his contention that the management of the Universities must remain in the hands of intellectual aristocracy and if this point were pushed a little further, we arrive at the conclusion that the civilian officer, however eminent and generous, is not best qualified to direct and control the fate and fortune of the education of one-fifth of the human population. The fact about education in India is that the power of formulating its policy is in the hands of well-meaning distinguished civilians but which ought to be really entrusted to those who have lived and acted education and have their being in education. Those in charge of the education of the country's youth will welcome Mr. Littlehailes' exhortation to the graduates and possibly to the under-graduates who must have been listening to him, to remember the difference between freedom of thought and freedom of action, the latter presumably including freedom of speech. There is so much flatulent rhetoric in the country filling the minds of people with the turbulence of a south-west monsoon that he would have been perfectly justified had he devoted some time to point out to the young men who are about to enter the world, the need for electing their legislators who give proof of their wisdom, balance, moderation and constructive power rather than a capacity for oratory. Mr. Littlehailes in referring to intellectual snobbery would have been right, had he dwelt on the unnatural gap between the educated classes and the less fortunate rural people, which it has created and had discussed the means and the methods of removing it; but by referring to the immensity of space and worlds in the celestial system, he preferred to convince the graduates before him that each one was not greater than the speck of dust in the room in which they were seated. Rather they should have been told that modesty is an inherent character of good-breeding, the direct outcome of true University culture and an offence against it virtually constitutes an indictment on one's inherited good qualities and the efforts of one's institution to improve them. If Newton and Darwin were models of modesty, it was because they were appalled by the enormity of their ignorance compared with the immensity of knowledge before which they stood like children and not because they were convinced that they were a speck in the vastness of cosmic space. After all egoism is a quality of the human mind and the whole celestial system falls within its province. Moreover, an amiable touch of that quality would seem almost indispensable to an enterprising and intrepid mind when it sets out to extend the boundaries of human knowledge by making fresh conquests. Every one that is interested in the progress of the country will sympathize with Mr. Littlehailes' plea for the cultivation of the vernaculars to be used as a vehicle for conveying profit and pleasure to the masses, and this is possible provided caution is exercised against the tendency of even the modern vernaculars becoming too learned and classic for the ignorant rural population. The Annamalai University, everyone will readily agree with Mr. Littlehailes in this respect, should concentrate on the humanities and leave technological studies severely alone, for it is of the regional type and the environment most suited for enhancing its sphere of usefulness, is philosophy, ethnography, anthropology, literature and fine arts, and not industry, commerce and technology.

There are one or two paragraphs in this otherwise able address which contain controversial subjects on which Mr. Littlehailes' opinions are likely to be called into question. According to him, the test of our ideal is how far it squares with the material facts of life and in his opinion India's greatest need is not the solution of unemployment problem nor a change in the industrial position, but the greatest need is to materialize the ideal testing it against the facts of life. In no part of the address could we discover him stating what this ideal is or ought to be and he has not specified the material facts of Indian life against which he calls upon the graduates to test the unnamed ideal. If by ideal we mean a mental concept of a standard of perfection which the mind continually yearns to attain but seldom reaches, clearly its test is not to square it with the material facts of life, for if you do, it must necessarily partake the character of practical expediency. The basis of an ideal is the innate craving of life to reach an unattainable excellence and in its efforts towards this end, modifies the material facts of life to be helpful for its progress and will ignore them if they are unalterable. But this is the first time we hear of the exalting of the material facts of life to which the ideal is to conform its scope and ambition. But what are the facts of Indian life?

1. Famine, poverty and malaria.
2. Over-population, unemployment and ignorance.
3. Political subordination, lack of initiative and helplessness.
4. Intercommunal jealousies, agitation and ordinance.
5. Social injustice and economic depression.
6. Good government, peace and order and progress of education and diffusion of Western sciences.
7. Great engineering works, cheap and rapid transportation, posts and telegraphs.
8. Improved methods of agriculture, rural sanitation and heavy taxation.

Is there any ideal on the part of any living individual which can be made to square with these facts? Even the exponent of this somewhat startling new theory may not discover one. Evidently there is a confusion of ideas. What Mr. Littlehailes probably means is the guiding principle of life, something in the nature of a motto which we distinguish from an ideal.

His conception of the aim of the University embraces a few possible and a larger number of impossible things and if any University were to set out to achieve some at any rate of these, it is bound to land in disappointment. "To research, to teach, to add to the stock of knowledge of the world, to wisely impart to its students some of the existing knowledge, to form the character of its students, to educate them to acquire a critical spirit, a balanced judgment and an independence of intellectual thought, to produce an attitude of mind which places the possessor on a different plane from that of his fellow and to so train its students as to enable them suitably to take up some profession and occupation in life." These infinitives will either provoke the smile or break the heart of the University Professors. The true function of the University is to provide in their professors and laboratory equipment, men and material which the students are invited to utilize to the top of their intellectual and moral bent and they can no more produce "character" in the alumni than they can transmute metals. The trouble with most men is that they are unable to realize adequately that the students' mind is a kaleidoscope, the pattern and colours of which are traceable to remote ancestry and any change in them must come from self-exertion and initiative on his own part. The University provides the most favourable environment for this self-expression which is true education. Any change imposed from outside can be neither valuable nor permanent. An exposition of the aims of the University such as Mr. Littlehailes has attempted, is apt to mislead the public to expect the impossible from the University teachers who will be held responsible, on the basis of this theory, to produce gold even if they are given pewter. They can only help the material to polish itself.

In spite of these somewhat debatable points, Mr. Littlehailes' address is a readable document containing much useful information. A. N. R.

Science News.

MESSRS. C. REICHERT of Vienna, have now placed in the market a new outfit for fluorescence microscopy (list No. 6065*e*) designed by Haitinger. The source of ultra-violet rays is an electric arc between two metal electrodes which, while providing an intense light, consume but a very low current. Several new features are incorporated in the outfit which enable its use for fluorescence photomicrography, as also for fluorescence spectroscopy and spectrography. The obvious advantages of fluorescence microscopy promise a great future for this branch of microscopic research and the firm of Reichert who are pioneers in the construction of fluorescence microscopes have now added a very useful instrument to research workers in this line.

* * *

We have received a copy of a pamphlet published recently by the Society of Biological Chemists (India), wherein is summarised the proceedings of the Symposium on "The Role of Organic Matter in Soil" held under the auspices of the Society on 30th July 1932. A report of the Symposium has already been published in the August number of *Current Science*. The present pamphlet gives more detailed abstracts of the papers presented at the Symposium and includes a full report of the discussion that ensued. This useful brochure will be read with great interest by all those working in the various branches of this important subject.

* * *

The beautifully printed and illustrated handbook *German Universities—A Manual for Foreign Scholars and Students* (published by the Deutscher Akademischer Austauschdienst E. V., Berlin C2, Schloss) gives a general account of the main features of the organization and character of the German Universities, the various aspects of German social and scientific life in the important University towns, to all who may intend to study in any of the German Universities. The publication is issued by the German Academic Exchange Service whose main object is to secure and foster cultural contacts with foreign countries. At present it is to be regretted that this exchange service maintains no working relations with any organization in India and it is hoped that the matter will soon engage the attention of the Indian Inter-University Board. The aim of the German Universities is well worth reproducing in the language of the statutes adopted by them.

"It is the task of the University to promote knowledge by research and instruction. In pursuance of this it must never lose contact with the vital forces of the country of which it is a part. It must prepare students for entrance into the various branches of higher state and public services, as well as for other professions which require a University training. As a community of teachers and students, united in the spirit of truth, it seeks to develop the normal character of the students and to educate them to responsible membership and collaboration in society, to the end that the national and cultural welfare of the people as a whole may be served."

This ideal is attempted to be reached by an academic freedom in teaching and learning and under its influence the student "is compelled to discipline himself and to acquire these principles of independent and responsible action that will guide him," in his University and extra-mural life.

The manual gives complete information regarding the types of Universities and institutions of higher learning, their administration, admission of students into them, the courses of studies and facilities of research offered by them, the tutorial methods and system of examination, the cost of study and living, excursions and social amenities, scholarships, descriptive accounts of university towns and other matters of special interest for foreign students.

It seems very desirable and even urgent that India through some central organization enter into working relations with the German Academic Exchange Service and other similar institutions in Europe and America and make known to students and others who may plan to study or

to travel in these countries, the facilities offered by them. If these service organizations could find the means for promoting and consolidating the intellectual sympathy and better understanding among the young men of different countries and abolish the mistrust and ignorance which separate them, then the cause of World Peace will be on the high road of accomplishment.

B. R. S.

* * *

Rao Bahadur Professor B. Venkatesachar, M.A., F.Inst.P., has been invited by the Annamalai University to deliver a course of five lectures on "Atomic Nucleus and Hyperfine Structure of Spectral Lines". These lectures which are intended mainly for Honours Students will come off on Monday, the 6th February 1933 and terminate on Friday, the 10th February 1933 commencing each day at 5 P.M.

* * *

Under the joint auspices of the Society of Biological Chemists (India), Bangalore, the Association of Economic Biologists, Coimbatore, and the Madras Branch of the Indian Chemical Society, a three-day meeting was held at Coimbatore on the 7th, 8th and 9th October. The Conference began on the 7th with a Symposium on "Utilization of Waste Products" presided over by S. V. Ramamurthy, Esq., I.C.S., Director of Agriculture, Madras. The following papers were read and discussed :—

"Sewage and Domestic Wastes." By Dr. Gilbert J. Fowler.
"Utilization of Farm Wastes." By Mr. K. S. Viswanadha Iyer.
"Utilization of Waste Vegetation." By Dr. V. Subrahmanyan.
"Waste Products of Paddy and Sugarcane Crops." By Rao Bahadur B. Viswanath.
"Waste Products of Dairy." By Mr. T. Lakshman Rao.
"Some Industrial Wastes." By Mr. M. Sreenivasaya.

On the 8th Mr. M. Sreenivasaya delivered an address on the "Present Status of the Problem of the Spike Disease of Sandal".

An interesting discussion followed which was continued on the 9th and which clearly proved that Spike was a disease due to some infective principle and not a physiological condition of the plant.

In the afternoon of the same day several original papers were read under the presidency of Dr. Fowler.

* * *

We acknowledge with thanks the receipt of the following :—

"The Indian Forester," Vol. 58, No. 10, October 1932.
"Chemical Age," Vol. 27, Nos. 690–693.
"Brooklyn Botanic Garden Record," Vol. 31, Nos. 1–4.
"British Association for the Advancement of Science—York Meeting," July 1932. Addresses, Journal and Transactions.
"Archiv Für Zoologie," Heft 23, Nos. 1–4.
"Bulletin of the Madras Government Museum," Vol. 1, Part 2.
"Transactions of the Mining and Geological Institute of India," July and September 1932.
"Nature," Vol. 130, No. 3284.
"Canadian Journal of Research," July 1932.
"Natural History," Vol. 32, No. 5.
"Journal of Urusvati Himalayan Research Institute," Vol. II.

Reviews.

MAXWELLIAN OPTICS, *Theory of Light.* By Professor Max Planck, translated by Prof. H. L. Brose. (MacMillan & Co., 1932, 8 vo. pp. 213.) Price 10*s*. 6*d*.

In the volume under review, which is a translation from the original German, Prof. Planck has given a very clear, compact and comprehensive treatment of "Classical" optics from the standpoint of Maxwell's theory of electromagnetic wave-propagation. In the concluding chapter, the connections between classical optics and quantum mechanics are set out. It is obvious to any one who has been a teacher of the subject that there is a great gain in treating physical optics from such a unitary point of view. The following though of a coherent train of thought is the essence of a good course of lectures, and, it may be added, also of a good book. The serious student who desires to obtain a grasp of optical principles without wasting time on details of minor importance must feel grateful for having such a volume as this put into his hands. The mathematical apparatus employed is comparatively elementary and is such as should be well within the capacity of B.Sc. (Hons.) and M.Sc. students of Indian Universities to understand.

The fact that the present book is the fourth of a series of five volumes by its distinguished author suggests certain reflections on the subject of the teaching of physics in Indian Universities which may not inappropriately find a place here. The astonishing rate of development of physics of recent years has made the adequate teaching of the subject a task of peculiar difficulty. It is quite natural and appropriate that much attention should be paid to the study of "modern developments" and that the more promising students should exhibit enthusiasm for taking up "research" as part of their syllabus of study. At the same time, it should be remembered that an edifice of ill-digested knowledge erected

on an insufficient foundation of preparatory study is worse than useless. A broad-based knowledge of mechanics, thermodynamics and electromagnetism with an adequate mathematical discipline such as is furnished by the published lectures of Prof. Planck should be compulsory for every advanced student of Physics. Only on such a foundation of knowledge, can the study of modern developments and the participation in research possess any real educational and intellectual value.

SIR C. V. RAMAN.

* * *

Annelida Polychaeta of the Indian Museum, Calcutta.

A monograph on the Polychaete worms of the Indian Museum collection by Prof. Pierre Fauvel, the distinguished French specialist which has recently been published in Vol. XII of the *Memoirs of the Indian Museum,* deserves special mention. Though primarily a systematic account of the collections in the Indian Museum, the work is really the first monographic attempt of the Indian species of this very difficult group of marine worms. The author has published in this work detailed synoptic keys of the families, genera and species of almost all the Indian Polychaetes and thus made it possible for future workers to identify their material, to some extent, without having to search through the very scattered and extensive literature on the subject. Some of the outstanding general conclusions of the work to which attention may specially be directed are as follows:—The Polychaete fauna of Indian waters does not materially differ from that of the Red Sea, the Persian Gulf, the Malay Peninsula and the Philippines, but many forms which are known in New Zealand, New Caledonia and Australia are also found in these waters. As a result of critical studies of the Indian material, 67 of the Indian species have been found to be identical with forms found in the Atlantic Ocean, English Channel and the Mediterranean. The coastal fauna, as might be expected, is generally richer in species than the deep-sea fauna where the biological conditions are much less variable and the animals are less influenced by extraneous factors such as influence the life in the inshore waters. The forms recorded and described from the brackish water areas, such as the Chilka Lake, the Cochin Backwaters and the Gangetic Delta, were found to be specially modified and peculiar. A further factor of interest about these forms was that identical species were found in collections from the Indian brackish water areas and the Taléh-Sap or the Inland Sea of Singgora, a brackish water lake connected with the Gulf of Siam.

B. P.

* * *

The Practice of Absorption Spectrophotometry. By F. Twyman, F.Inst.P., F.R.S. (with the collaboration of the staff and advisers of Adam Hilger, Ltd.) (Adam Hilger Ltd., London.)

The subject of "Absorption Spectrophotometry" is of late finding such high favour among an increasing army of scientific workers—Bio-chemists in particular—that Messrs. Adam Hilger, Ltd., have, by publishing this useful little volume, earned the gratitude of many workers in this field. The first five chapters have been written in a lucid style by F. Twyman, F.R.S. and deal with the nature and laws of absorption, the apparatus and technique of absorption spectrography in the ultra-violet, visible and infra-red regions, and the application of Photo-electric methods to Spectrophotometry. Detailed instructions regarding the use of the Hilger instruments, their adjustment and alignment, selection of exposures, taking and recording of results, etc., are also carefully given that an adherence to the instructions given is bound to be valuable in this line of investigation.

The staff and advisers of Messrs. Adam Hilger, Ltd., have contributed the following three chapters in which are outlined the salient features of "Absorption Spectra and Molecular Constitution", "Biological Applications of Spectrophotometry" and "The Detection and Investigation of Poisons and the Control of Purity in Foodstuffs". A review of the present knowledge on absorption spectrophotometry as related to Vitamin D and allied topics is contained in section (*b*) of the chapter dealing with Biological Applications and should be able to convert a large number of vitamin specialists to the adoption of spectrophotometric methods in their work. A brief outline of emission spectrography as applied to the study of the above problems forms the subject-matter of appendix A, while in appendix B is given a short and general outline of the Raman Effect.

P. S.

* * *

Recent Applications of Absorption Spectrophotometry. (Adam Hilger, Ltd., London.)

This is an extensive collection of Bibliographical references to the subject of absorption spectrophotometry and serves as a companion volume to the previous book. It is needless to stress the usefulness of such a list of references.

P. S.

* * *

Indian Caste Customs. By L. S. S. O'Malley (University Press, Cambridge, pp. ix+190. 6*s*. net.)

The present volume on the fascinating subject of "Indian Caste Customs" contains nine chapters, each of which is devoted to a special topic on caste. Leaving the endless discussions on the origin and evolution of caste to the arm-chair philosophers of Europe, the author gives in the first four chapters a brief summary of the caste system, caste government, its controls and penalties.

Hindu society is divided into a number of divisions known as castes which are graded in order of social precedence and each caste again is divided into a number of sub-castes. To a student of Social Anthropology the modes and formations of castes and sub-castes which are taking place all over India are of peculiar interest.

The caste system is least precise on the northern borders of the Indian Empire, in Assam, the Panjab, the North-West Frontier Provinces, Kashmir, Sind and Nepal and very strict in South India. Regarding the caste government the author mentions the salient features of the old Panchayat system assisted by the elderly members. The lower castes are much better organized than the higher ones whose machinery for the regulations of their affairs have already become lax. Ordinarily it deals with all questions arising within its jurisdiction and its permanence and authority do much to promote the solidarity of the castes and to preserve the discipline among its members. But for grave and important matters, it gives place to a general assembly of male members of the caste. Even then the members of the council guide the discussions and have a large voice in the final decision. On grave offences of caste the rulers of the Indian States are the final authorities. There is a regular code of punishments for the delinquents which are graded according to the gravity of the offences. The next four chapters deal with the marriage, morals, food and drink, occupation and the untouchability. It is sometimes said that the caste institution exists more for its regulation and maintenance of marriage customs and for preservation of chastity. Marriage must take place within the caste or sub-caste. A girl may be married within her caste and must be among members who are not related but never below. Here the elaborate rules of prohibition are in force to prevent marital relations among those who are closely related. Any violation of these rules will result in expulsion from caste. Thus caste preserves chastity in women. Equally important are the rules connected with food and drink about which the caste men are very particular. To a large extent occupation is the basis of caste and under modern industrialism based on mechanical inventions, traditional occupations of caste are declining and the caste men either relinquish their traditional occupation in favour of more lucrative ones or take to another to supplement their income. Regarding the untouchables it is curious to note that they constitute a well-defined distinct caste with sub-divisions of its own. Its peculiar usages and traditions as also its own jealousy of the encroachment of the castes which are above and below it. They are equally with the higher castes filled with that compound of pride of birth, exclusiveness and jealousy called "caste feelings". Regarding the caste organization of India there are scholars who condemn it as "the most disastrous and blighting of all human institutions", and one has described it as "a gigantic system of cold-blooded repression", while others have opined that caste has been useful in promoting self-sacrifice, in securing subordination of these individuals to an organized body, in restraining from vice, and in preventing pauperism. It must be said that caste has been a marvellous discovery, a form of socialism which through ages has protected Hindu society from anarchy and from the worst evil of industrial and competitive life.

Mr. O'Malley has to be congratulated on the production of an interesting volume which all students of Social Anthropology and the layman will much appreciate.

L. K. A.

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